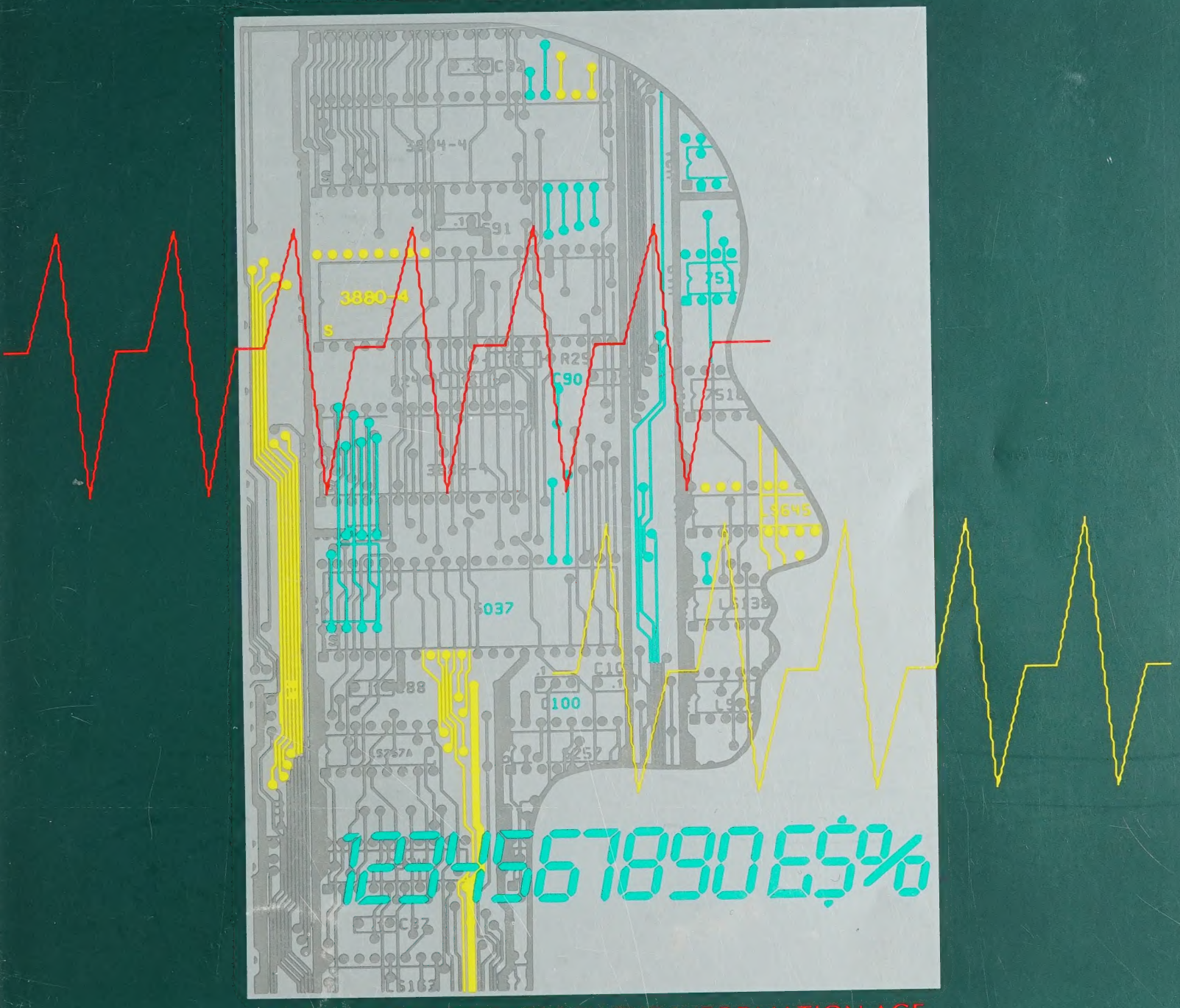
COMMUNICATIONS FOR THE TWENTY-FIRST CENTURY



MEDIA AND MESSAGES IN THE INFORMATION AGE

Communications Canada

Canada

This document is also available in PC DOS 5½" format.

COMMUNICATIONS FOR THE TWENTY-FIRST CENTURY

MEDIA AND MESSAGES IN THE INFORMATION AGE

Cat. No. Co22-78/1987 E
ISBN 0-662-15730-3

TABLE OF CONTENTS

1 INTRODUCTION

This paper is about Canada's future and the roads that will lead us to it.

Communications have always played a central role in Canada's history. From the fur trade of the seventeenth and eighteenth centuries, to the canals and railways of the nineteenth, from the broadcasting networks, airlines and highways to the telephone and satellite systems of the twentieth, communications technologies have helped Canadians reach new frontiers, settle and develop the wilderness, and build both a society and culture that are unique in the world for the degree to which they depend on good communications systems.

By using communications to discover and express our common goals, we have consistently overcome forces that call into question Canada's vitality as a nation. The geography of North America, the distribution of its people, and their distinct cultural identities are a constant challenge to Canadian nationhood. There is a permanent tension between these forces and our will to live and succeed as Canadians. Above all else, this tension requires us to communicate.

In pursuing our national dream, we have developed the world's best communications system. In Canada, a higher percentage of households has telephones than in any other country, and the average Canadian has access to more television channels than anyone else. We can be particularly proud of our achievements in providing a high level of telecommunications and broadcasting service to people living in the most remote parts of our country. In urbanized areas, Canadian businesses have access to data communication services as good as any in the world.

The central role of communications in Canadian life has helped make the communications industry Canada's leading area of high technology achievement. More than one quarter of our industrial research and development involves communications, and Canadian firms are known around the world for the excellence of their communications products, systems and services.

Today, Canadians are faced with a new communications challenge.

Like all industrialized countries, Canada is in the midst of a profound shift in the foundations of its economic and social life. In the past three or four decades we have come to rely progressively more on the creation, communication and consumption of information as a source of jobs, wealth and social progress, and less on the exploitation of raw materials and physical labour. This trend will almost certainly continue into the foreseeable future. As a steady stream of government reports and popular bestsellers has told us, we are rapidly becoming an information-based society. Most observers agree that this shift is of comparable historical significance to our earlier transition from an agricultural to an industrial society.

Underlying this shift is a new communications infrastructure which is as important to the information age as were rivers, railways, and highways to earlier eras. It is made up of machines for creating, storing and exchanging information ranging in power and complexity from the telephones and television sets found in our homes, to the automatic tellers and point-of-sale terminals that process our daily financial transactions, from the word processors, desktop computers and facsimile machines used in offices, to the giant mainframes and supercomputers that run banks and stock exchanges, help governments deliver social services and aid in forecasting the weather. These machines are tied together by complex telecommunications networks, the central nervous system of the information society.

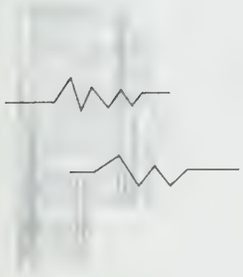
In recognition of the role these machines and networks will play in Canada's future, the Science Council has called this new computer-based communications infrastructure a transformative technology, and has stated that it will have the greatest impact of all emerging technologies on societal change between now and the end of the century.

As well as changing the shape of Canadian society, the new communications are rapidly changing the international landscape. To borrow the title of the far-sighted 1971 report of the Telecommission, they are creating an "Instant World" by reducing or eliminating barriers to the movement of money, goods, services, ideas and people. They are helping to make the world more intimate and more competitive.

Today, Canadians are faced with a new communications challenge.

. . . we are rapidly becoming an information-based society.

In the past decade, all the major industrialized countries have recognized the central role of the new communications and computers in economic and social development. Without exception, they have adopted strategies aimed at developing communications infrastructures for the new information age. These strategies are broadly based. They involve a number of elements including massive research programs, social experiments to encourage technology diffusion, and reform of laws and regulations to create a more efficient and innovative environment for the production and distribution of communications goods and services. In many cases, they are explicitly linked to wider strategies for industrial development and trade.



In spite of the basic strength of Canada's communications system, we have weaknesses in several key areas . . .

In spite of our past achievements in communications, Canada has not reacted to the changes that are taking place in our own economy and in the larger world in the same way as other advanced industrial nations. We have been content to rest on our laurels, believing that no special efforts are required to cope with the challenges of the new environment.

It is time to call this complacency into question.

In spite of the basic strength of Canada's communications system, we have weaknesses in several key areas which must be overcome if we wish to build the new communications infrastructure we need for the information age.

These weaknesses are found in the industries that produce the information resources on which our economic and social welfare increasingly depend, in our fragmented arrangements for regulating our communications networks, in the relatively slow rate at which we take up and apply new technologies and in the uneven development of our national communications research effort.

The main aim of this paper is to open a discussion on the measures that should be taken over the next few years to deal with these weaknesses. These measures will require the active support of many Canadians — federal and provincial governments, business and labour organizations, universities and social service institutions, consumer and voluntary associations. It is to these groups that this paper's proposals are primarily addressed.

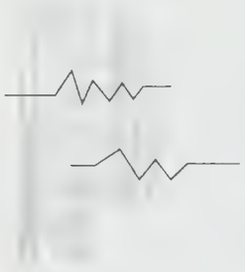
Canada's transition to an information society is, to paraphrase Clémenceau, too important an issue to be left to the specialists. The changes in economic and social life which the information society will bring about should be of concern to every Canadian, since they will affect the way we live, the way we work, how we are educated, how we use our leisure time and how we interact with others in our communities, across the country and throughout the world.

In analysing the challenges facing Canada, we have focussed on four main questions:

- the development of the new information industries and their software and database products;
- the evolution of the networks that carry these products;
- ways in which these products and networks can be used more effectively to meet our goals for economic, social and cultural development; and
- the national research effort required to underpin all these objectives.

This paper is written from the point of view of Communications Canada and is grounded in the department's traditional preoccupation with the evolution of communications networks and the creation of Canadian content. It is not, however, restricted to these concerns.

As new media and their messages become increasingly central to all aspects of our social and economic life, the discussion of communications inevitably broadens to embrace subjects that have traditionally been remote from the department's mandate. Many of the questions raised in this paper touch on the domains of other federal government departments, the provinces and the private sector. We hope that although this paper is written from a communications perspective that its analysis will be of interest to other organizations and their clients and will encourage them to contribute to the debate on the information age.



The changes . . . which the information society will bring about should be of concern to every Canadian . . .

The four issues listed earlier are central to Canada's evolution as an information society. However, we recognize that there are other questions that need to be addressed as well.

A second aim of the paper is to give an overview of what the information society is all about and to identify some of the longer-term issues it raises for Canada.

The information age will change our political life, just as much as it will our economy and society. If we remain true to our democratic traditions, it will put an increasing emphasis on informed public discussion and debate as a precondition to effective political decision-making.

Thus, in the spirit of the new age, this paper is addressed to all Canadians who are concerned about our country's future.

Thus, in the spirit of the new age, this paper is addressed to all Canadians who are concerned about our country's future.

2
THE INFORMATION SOCIETY

Viewed in close-up, the information age is a time of rapid change.

In the past 10 years, we have seen a radical restructuring of the world economy. New nations have risen to prominence as old powers have declined, their fates tied to their relative success or failure in developing and exploiting the new resources of the information age. Today, Japan, Korea, Singapore and other countries of the Pacific Rim enjoy new-found wealth, while North America and Europe look to them for lessons on how to prosper in the electronic era.

The same 10 years have produced a dazzling array of new products and services which have moved with unprecedented rapidity from research labs and market trials to homes and offices around the world. Satellite receivers, pay television, videocassette recorders, personal computers, electronic newspapers, electronic shopping, home banking, component television, enhanced television, walkmen, CD players, CD-ROM — the list is already long, with no end in sight.

Information sources have proliferated over this period to the point where many people feel overwhelmed by the sheer volume of what there is to be known or learned about almost any subject that interests them. It has been estimated that the world's stock of information is doubling every two years.

But there is another side to the story.

Before we look into the heart of the information society — at the industries that produce information, the networks that move it, the corporations and institutions that use it and the scientists who study its technical and human facets — we need to step back and examine the long-range social, economic and technical trends responsible for the ascendancy of the information society. Only by understanding the long-term nature and direction of change can we chart a course for the future.

To comprehend the information age, we need to begin not 10 years ago, but 40 years ago.

A baseline for measuring change

The Canada of the late 1940s was a very different country from the Canada we know today, still somewhere between past and future, poised at an historic turning point.

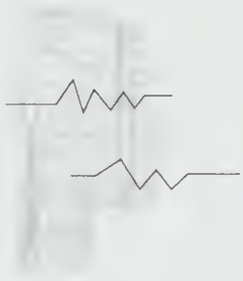
Canadians had just emerged from a war and achieved new status in the councils of the world.

They were shaking off the effects of a post-war depression and re-starting a peacetime economy which would produce a decade of unparalleled growth and prosperity, and were beginning a series of social experiments which would permanently alter their expectations of government and reshape the mechanisms for distributing wealth in society.

The Massey Royal Commission on National Development in The Arts, Letters and Sciences was setting out to highlight and develop Canada's distinct identity.

It was a time of change in which the seeds of the future were already being nurtured. Over the next 40 years, Canada's economy, society and culture would be entirely transformed.

Today, the effect of these changes is seen everywhere, but perhaps nowhere more dramatically than in the shifts that have taken place in the structure of the Canadian economy during these years.

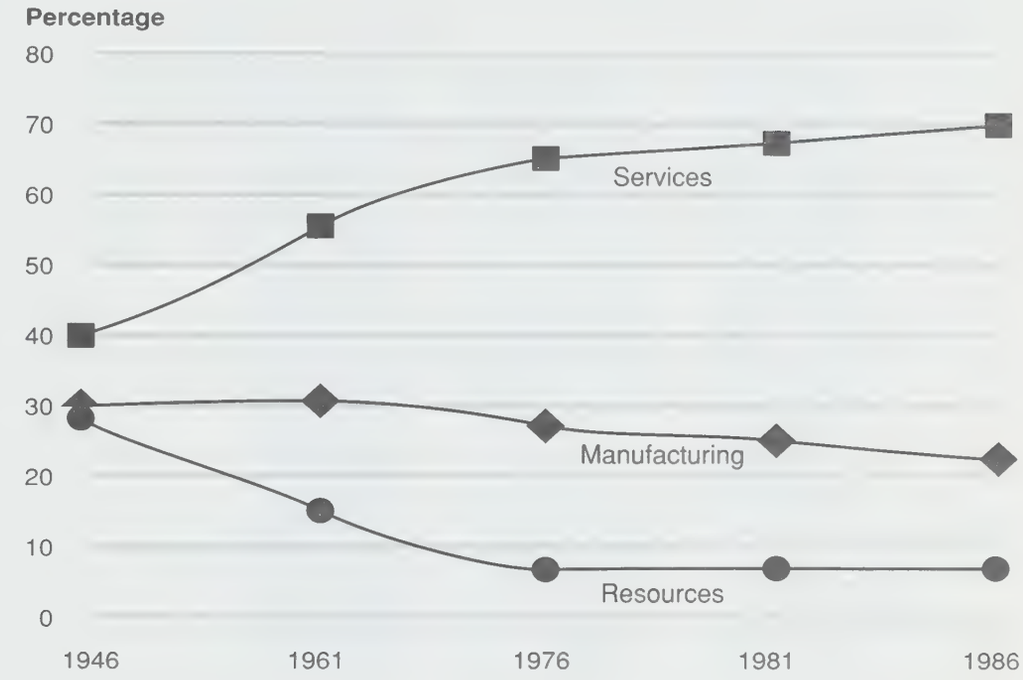


Today, the effect of these changes is seen everywhere . . .

A changing economy and work force

Over the past 40 years, the economy of the so-called "tertiary" sector — that part of our economy concerned with services and administration, what we now increasingly call "information work" or "knowledge work" — has grown faster than agriculture, faster than the resource sector, faster than manufacturing.

CHART 1
EMPLOYMENT BY INDUSTRY SECTOR



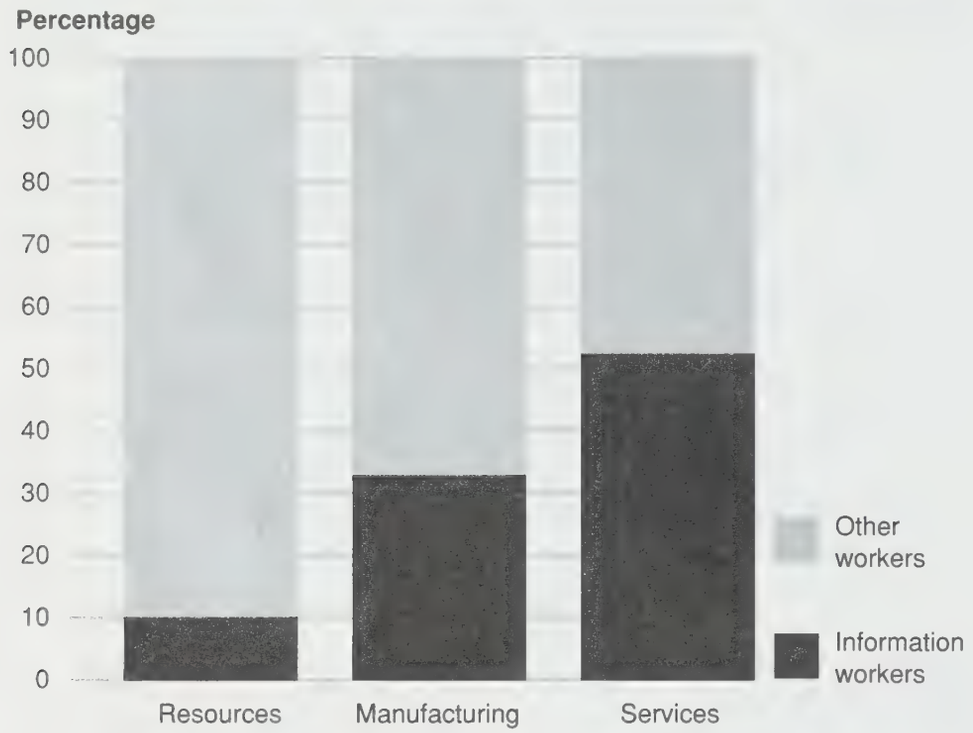
Source: Statistics Canada

Using OECD data . . . information workers account for 45 percent of total employment.

In 1946, less than one person out of two (41 percent) was employed in a sector designated by Statistics Canada as "service"; by 1986, the figure had risen to more than two out of three (71 percent). Over this same period, the overall percentage of people employed in the manufacturing sector declined from 30 percent to 23 percent. The percentage of people employed in the resources sector fell from 29 percent in 1946 to 7 percent in 1986.

Another way to consider the changed nature of the labour force is to examine the percentage of "information workers" in each sector. Using Organization for Economic Co-operation and Development (OECD) data and applying it to 1986 Canadian employment data, information workers account for 45 percent of total employment. Even more significantly, information work is evident in the primary and manufacturing sectors as well as in services.

CHART 2
INFORMATION WORKERS AS PERCENTAGE OF ALL EMPLOYMENT, 1986



As Statistics Canada has pointed out, the increasing importance of the service industries is related to the rise of the "information economy." For these industries, the processing, analysis and dissemination of information form the basis of much of the service they provide. The other sector of the service economy which almost doubled in this 30 year period was "non-commercial services," that is, education, health and welfare, and public administration. There too, as Statistics Canada observes, we are dealing with a sector which is information dependent.

Changing messages

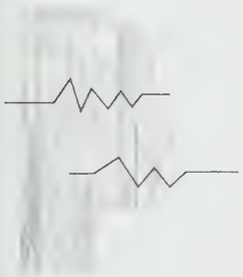
The rise of the information society can be measured not simply by the increase in the number of information workers, but also by the growth of the industries that produce and market information products.

Having the right information at the right time has always provided enormous strategic advantages.

Having the right information at the right time has always provided enormous strategic advantages. In 1815, prior to the battle of Waterloo, Baron Rothschild placed agents with carrier pigeons between the probable scene of the battle and London. He managed to obtain news of France's defeat long before anybody else did. Counting on the fact that his business competitors would believe he had obtained accurate information, he appeared at the London Exchange and began to sell everything he owned. Assuming England had lost, his competitors immediately followed suit. In the ensuing panic, Rothschild bought his competitors' businesses at rock-bottom prices and made a fortune.

As the nineteenth century progressed, carrier pigeons gave way to new media — to telegraphs and telephones, to photographs and moving pictures, and ultimately, in the twentieth century, to radio and television.

During these decades, thanks to public education and growing leisure time, the market for newspapers, magazines and books increased enormously, fuelled by an ever-increasing stock of political, financial and scientific information. As well, World War II produced a spate of significant communications developments — from the computer and radar to the documentary film.



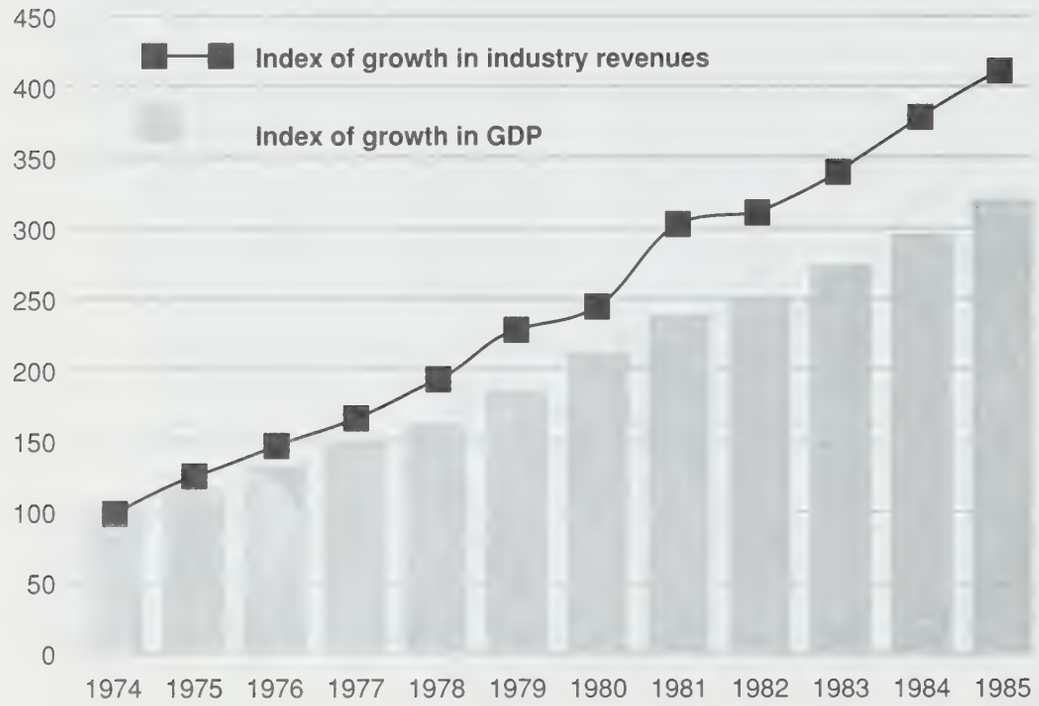
By 1946, Canadians would have felt justly amused and just a little smug at the simplicity of Rothschild's stratagem. After all, most Canadian cities enjoyed at least two daily newspapers, which competed in bringing them news of the nation and the world. They could also tune into radio stations for everything from "Hockey Night in Canada" to "The Happy Gang."

. . . over the past decade . . . publishing, broadcasting, film, video and sound recording, have grown faster than Canada's GDP.

In southern Ontario, the skyline was becoming cluttered with rooftop antennas installed to receive television signals from across Lake Ontario. For the time being, however, television was little more than an electronic oddity, no threat to neighbourhood theatres and their dazzling silver screens which were the primary medium for mass entertainment and fantasy.

Forty years later, these media are all still with us, and doing better than ever before. We may have fewer daily newspapers and our movie palaces may all have been subdivided into ciné-boutiques, but over the past decade, the traditional information industries, including publishing, broadcasting, film, video and sound recording, have grown faster than Canada's Gross Domestic Product (GDP).

CHART 3
EXISTING INFORMATION INDUSTRIES
INDEX OF GROWTH



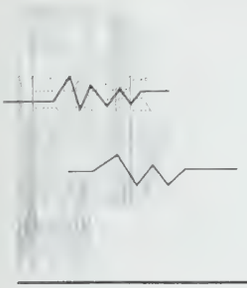
Publishing, broadcasting, film, video and sound recording

Note: Indices are based on aggregated industry revenues and values of GDP measured in current dollars, with 1974 equalling 100.

Revenues (in current dollars) for these four industries have grown from nearly $4.5 billion in 1977 to over $11 billion in 1985, which represents almost a three-fold increase in the market value of the information products they sell in Canada in less than a decade.

But the difference between 1946 and 1986 is more than the difference in the revenues of these established information industries. Today, entirely new businesses have entered the information marketplace.

What makes these businesses different is that they sell information coded in electronic form in the "digital" language of computers and not in printed words or numbers, nor in recorded sounds or images, nor in any of the other analogues to human sense and speech which people have devised over the millenia to help them communicate.



. . . the digital language spoken by computers is a universal language of remarkable power, efficiency and flexibility . . .

This distinction is important because the digital language spoken by computers is a universal language of remarkable power, efficiency and flexibility which can represent numbers, words, sound and images with equal facility. It can express any single message or any combination of messages, something no other communications medium has ever been able to do. For example, using a computer, it is possible to annotate a written document with a voice message, something that cannot be done with a book. While film and video productions can convey words and music as well as pictures, they cannot give an audience the opportunity to participate in telling the story, as interactive computer programs can.

The new information industries sell the contents of computer memories, which are commonly called databases. They do this either "online" through telecommunications links, or in "standalone" form, on tapes, discs or other electronic storage media. The information contained in individual databases can also be combined with other databases, processed and analysed to meet individual needs. In many cases, these databases are direct substitutes for more traditional information products like magazines and newspapers; in others, they provide access to information never previously available.

At the time of writing, there are more than 3,000 such databases available, providing information on everything from stock market quotations to medical information, scientific abstracts, horoscopes, political history, books in print and specialized business intelligence. They are increasingly penetrating all aspects of commercial, academic and government life. Indeed, in some countries — most notably France and the United Kingdom — they are now broadly available to the public at large and designed for the use of average consumers.

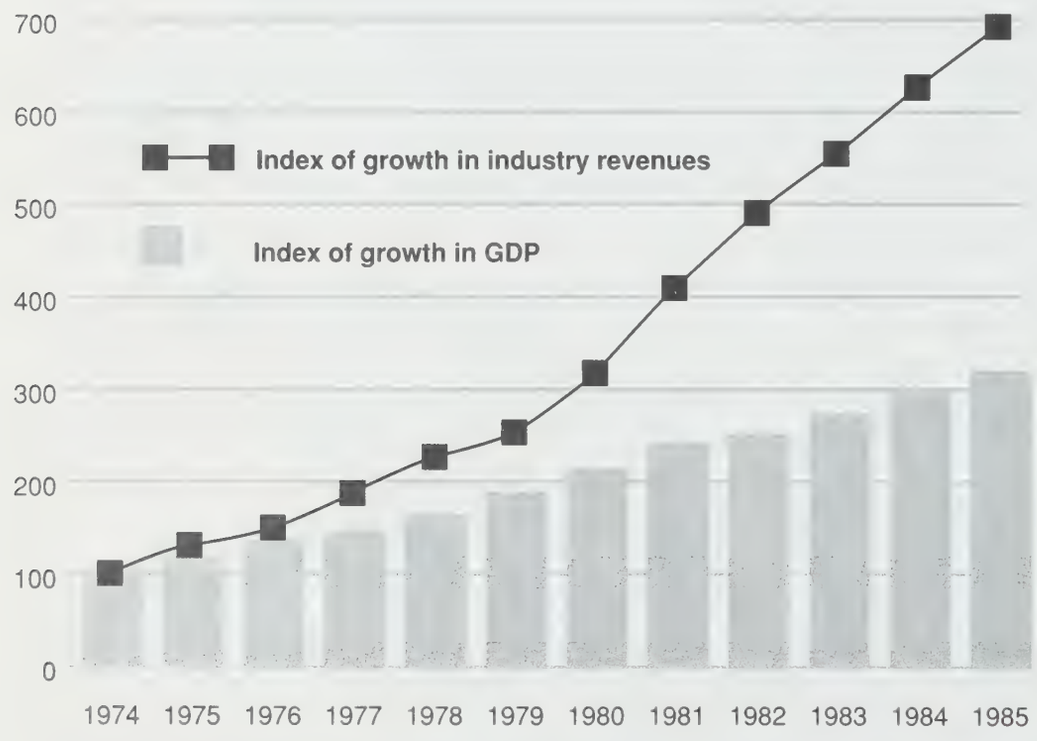
The other key product of the information industry is the software that controls the processing of electronic data and directs their flow between the computer memory and the final user. Perhaps the most glamorous and visible of these is packaged software designed for mass market consumption. Although this industry is not yet 10 years old, its products are already central to the operations of almost all offices. Spreadsheet and word processing programs are available in bewildering variety and are in use everywhere.

More recently, the packaged software industry has moved into products that — like those of the database industry — are substitutes in many cases for traditional information products. Accounting programs and tax packages substitute for endless libraries of interpretation bulletins; courseware on everything from learning physics and French to mastering history and geography is substituting for text books; interactive software novels — in which the outcomes of the plot are shaped by the reader — are emerging as alternatives to the fixed story.

The new information industries, like their traditional predecessors, are also growing faster than the GDP.

The new information industries, like their traditional predecessors, are also growing faster than the GDP.

CHART 4
NEW INFORMATION INDUSTRIES
INDEX OF GROWTH



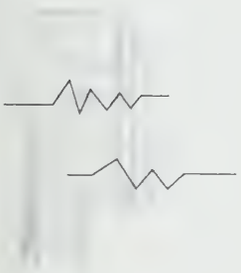
Software and EDP industries

Note: Indices are based on aggregated industry revenues and values of GDP measured in current dollars, with 1974 equalling 100.

Indeed, the rate of increase in the contribution to GDP of these new information industries has eclipsed that of the traditional information industries. While the combined contribution to GDP of the broadcasting, film, video, sound recording and publishing industries almost tripled between 1977 and 1985, revenues in the new information industries have, between 1974 and 1985, increased 7-fold from $300 million to $2.1 billion (current dollars) while the GDP itself only doubled.

Changing media

The information industries, whether old or new, depend on networks to distribute their products. Some of these networks rely today, as they have for the past two or three hundred years, on physical transport. Books are shipped by truck, and even if a morning newspaper is locally printed using a satellite feed from a distant city, a paper boy or girl usually carries it the last mile. Other information products — radio and television programs for example — have been distributed electronically since their inception.



The rise of the new information industries is intimately tied to the development of new kinds of networks which unite the technologies of computers and telecommunications.

If we were to return to our baseline year, 1946, we would find a telecommunications system very different from that which we know today. Telephone sets came only in black; the pastel hues, pushbuttons, convenience features and wireless capabilities, which can be bought in any hardware store today, were then far in the future.

Today, 98 percent of Canadian homes have telephones . . . In 1946, the figure was only 44 percent.

Today, 98 percent of Canadian homes have telephones, the highest percentage in the world. In 1946, the figure was only 44 percent.

Outside the city, party-line service was the rule rather than the exception.

In 1946, rather than call long distance, most Canadians would have sent a telegram, a service which has all but disappeared today.

Forty years ago, the idea of a geostationary communications satellite system had just been described in a visionary paper by Arthur C. Clarke, and it was to be another quarter century before Telesat gave Canada the world's first domestic geostationary commercial communications satellite system.

The computer industry was not much further advanced. Although Charles Babbage had defined the essential operating principles of a computing machine over 100 years earlier, and vacuum tube computers had been constructed during World War II, William Schockley and his colleagues at Bell Labs were only just on the verge of discovering the transistor, a breakthrough that would make computer technology a practical possibility.

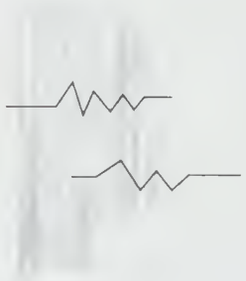
In 1946, it would have been very difficult to foresee the incredible rise of the computer industry and the astonishing range of computing devices — from mainframes, to minis, to micros, to special purpose chips — which have infiltrated every aspect of our daily lives.

It would have been equally difficult to forecast the remarkable development of the global telecommunications system, the intricate web of copper cables, optical fibres, satellite channels and radio links that connect not just people, but computers and all manner of intelligent machines in the biggest, most complex construction ever devised.

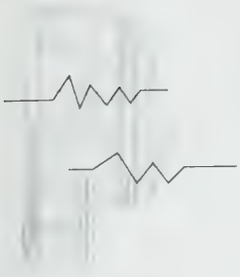
It would certainly have been impossible to anticipate the mergers and rivalries that would unite these two related, but very different industries in a race to develop and control the electronic highways of the information society. The corporate strategies of companies such as AT&T, IBM, Northern Telecom, Unisys and Rolm and the shifting alliances between major players are to the late twentieth century what the battles of the railway, steel and oil barons were 100 years ago.

All these changes spring from the convergence of the technologies underlying computers and telecommunications which could be characterized as the computerization of communications.

In the telecommunications industry, convergence was spurred by the adoption of the digital language used by computers to code and transmit messages. Northern Telecom, a Canadian company, was the world leader in the use of this technology which opened the way not only to



. . . these changes spring from the convergence of . . . computers and telecommunications.



The principal challenge of the computer industry is now a communications challenge . . .

more efficient computer-to-computer communications, but to the introduction of computer technology at every stage of the telecommunications process. As computers replaced mechanical parts in terminals, switches and transmission devices, the telecommunications system increasingly came to resemble a gigantic computer which could be programmed to convey an astonishing range of messages and services.

On the computer side, the key change was the development of what were called distributed data-processing systems. As originally conceived, computers were literally standalone devices, carefully isolated from outside influences in air-conditioned, dust-free rooms fed on a diet of punch cards and tapes brought to their sanctuary by specially-trained programmers.

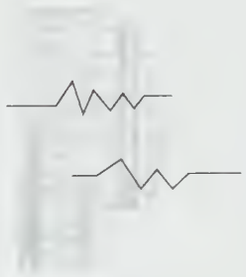
The development of services that enabled people to gain access to computers from remote terminals using telecommunications lines began to change this rarefied world. Although the first such terminals were "dumb" — that is, without any built-in intelligence — the growth of "online" and "time-shared" services in the late 1960s and early 1970s began moving the computer industry into the communications game.

The rapid development of microelectronics in the 1970s, which brought a host of intelligent terminals such as personal computers, word processors, computer-assisted design workstations and robots, completed this revolution. The principal challenge of the computer industry is now a communications challenge — to tie all these devices together in systems which enable them to exchange data with each other and with the large computers that are still the core of the business.

Whether we call the new networks "intelligent telecommunications systems" or "distributed computing systems," they have the same function — to permit people or machines to share and exchange information which is coded in digital form.

In other words, the rapidly converging telecommunications and computer industries are building electronic highways that are the principal media for conveying the products of the new information industries. Increasingly, we must think of computers, communications and the content they carry as a unified system.

The information society: some perspectives



To truly understand how different things are today . . . we need look no further than the experience of individual Canadians . . .

The changes in the economy, the work force, messages and media described earlier measure our progress over the last 40 years toward the information society. To truly understand how different things are today from the way they were in 1946, we need look no further than the experience of individual Canadians which illustrates, better than any graphs or statistics, what is now possible.

- There is the case of one young woman who was working as a stockbroker in Ottawa and putting her husband through medical school. They both preferred to live in a rural setting, however. Upon his graduation, the husband, supported by his wife, decided to take a position as a country doctor in Wawa, Ontario, a small town on the north shore of Lake Superior. Not so long ago, that would have marked the end of this woman's career as a stockbroker. But, with the consent of her company, she was equipped with a computer communications system that enabled her to continue to trade on the Toronto stock exchange from the shores of Lake Superior. She was so successful that she was eventually lured away from her original employer by one of the giants of the American financial services industry. This conglomerate now has offices in New York, Chicago, San Francisco and Wawa.

- Memorial University in Newfoundland, has been extensively involved in the development of satellite and terrestrial-based health care delivery systems in Newfoundland and Labrador. Current communications systems link hospitals and clinics throughout the provinces with the Tele-Health Centre established at Memorial. The Tele-Health Centre has also developed an offshore service that is in use not only in Newfoundland, but elsewhere. Several Canadian teaching hospitals, using this service, have been training doctors in Uganda and Kenya without leaving home. The patients' cases, complete with their histories and charts, are sent from Jomo Kenyatta hospital in Nairobi to the Hospital for Sick Children in Toronto. The professors in Toronto can then discuss the cases directly with resident pediatricians in Nairobi.

- The Grassroots database has been offering farmers in Manitoba home access to agricultural information for the past five years. This database provides stock prices from the Chicago exchange, hourly weather maps and forecasts and access to up-to-date information on pesticides and herbicides compiled by Manitoba's Department of Agriculture.

- Students at North Saanich School in Saanich, British Columbia, are participating in an innovative project to test leading-edge teaching technology. In a specially designed classroom, students' computer terminals are connected to a network that links them to educational software packages, gives them access to information in remote databases, and lets them send electronic messages to children in other parts of North America. They can even trade video images with a similar classroom in California. Teachers can use the computer system to monitor students' progress and analyse their writing. And an overhead screen displays teachers' and students' monitors, along with other video sources such as cable television. In this classroom, everything is connected electronically.

These examples illustrate the increasingly pervasive impact communications and information technologies are having on people's lives and on the way business is conducted in an ever-widening range of industrial pursuits.

While it is impossible to determine the final outcome of these transformations, there is every reason to expect these trends to continue. With innovations being diffused at a quickening tempo, these technologies, increasingly inexpensive and easy to use, are becoming available to people in numbers never before thought possible. And it must be borne in mind that much of this technology is little more than five years old. Personal computers, cellular telephones and compact discs to store music or data are now familiar products to many Canadians. We may have to think twice to remember that they came onto the market so recently.

The estimate which is perhaps most indicative of the nature and magnitude of change is the OECD projection that to date, only 10 or 20 percent of our existing stock of information technology has been exploited commercially. In the OECD's view, it will take another 15 years to realize the economic and social potential of this technology. The world will not stand still during this time. The rate of invention is likely to quicken, and with it the pace of economic and social change.

Effective communication comprises two elements: the medium and the message. In the next two chapters we will examine the development of the industries that produce messages and provide the infrastructure for transmitting them. As we shall see, these industries lie at the heart of the information society, and their development is a prerequisite to growth in all other economic sectors. They are one of the strategic keys to Canada's future.

. . . to date, only 10 or 20 percent of our existing stock of information technology has been exploited commercially.

3
THE NEW COMMUNICATIONS: MESSAGES AND PRODUCTS

Since the time of Gutenberg, most information products have been printed on paper; they include newspapers, magazines, books, plays, musical scores, journals and specialized reports.

The twentieth century has seen a greatly enlarged range of information products made available to Canadians, principally through techniques for recording sound and images on records, audio and video tapes, film and laser discs.

Today, new products are being created which will carry this evolution one stage further. Words and numbers, sounds and images, all can be compiled and stored electronically. When lodged in the memory of a computer or stored in machine-readable form, these products are known as databases. Computer software is the means for creating, processing and accessing them, the twentieth century equivalent of Gutenberg's printing press. Together, databases and software are the cornerstones of the new information industries.

Databases

Databases constitute a rapidly growing category of information products whose importance stems from the fact that an increasing proportion of information is now being created in electronic form. Newspaper reporters no longer pick out their stories on manual typewriters; they compose online to a central computer that also directs the operations

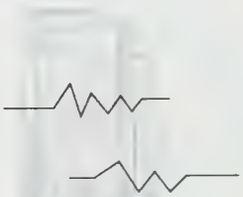
of the printing plant. In some cases — Toronto's *The Globe and Mail* for example — the content of the newspaper is shipped in electronic form via satellite to computers in other cities, where the paper is printed for delivery to readers at the same time as it hits the street in Toronto.

Existing stocks of information in printed form are also being converted into electronic form for storage and retention. Stock market quotations dating back to the end of World War II are now available in machine-readable form from Dow Jones. This allows analysts to track the performance of particular companies or market segments over several decades, considerably strengthening their ability to detect patterns and project future performance.

Users can gain access to databases in two ways. Databases that are continually updated to provide information on rapidly changing subjects such as currency exchange values, stock market quotes, airline and train schedules and weather reports, credit verification and financial services — including automatic teller machines — and medical emergency services are tapped through telecommunications lines by using telephones, television sets and computers. These are called online databases.

There are also relatively unchanging databases that can be distributed in a permanent physical form such as on optical or magnetic disc. These are standalone databases, such as the Grolier Encyclopaedia, Edition Logiciel's speaking French-English dictionary or the extraordinary new version of the Domesday Book, all of which are distributed on optical discs with permanently imprinted or "read-only" memory content.

In both cases, the use of microcomputers is vastly increasing the usefulness of this instantaneous access to information. A microcomputer equipped with the proper software tools permits users to do their own information searching and retrieval, rather than their having to rely on a skilled information professional such as a reference librarian. The Canadian On-line Enquiry Service (CAN/OLE) run by the Canada Institute for Scientific and Technical Information (CISTI) of the National Research Council enables researchers to consult a wide variety of international and Canadian scientific databases. Developments of this kind have the potential for greatly increasing the use of electronic databases.



. . . the use of microcomputers is vastly increasing the usefulness of this instantaneous access to information.

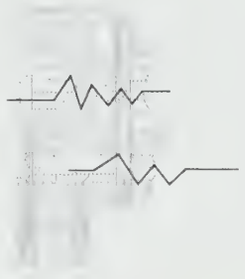
The database industry consists of three principal groups of players: information providers, database producers or publishers, and database distributors or retailers.

- Information providers are the organizations that originate or create information. They are equivalent to authors in the publishing industry. As in other industrialized countries, the federal government is the largest single creator of information in Canada. For example, the Canadian Socio-Economic Information Management System (CANSIM) database contains over 250,000 indices relevant to Canada's economy and society. There are also a number of private sector information provider organizations such as Montreal's IST Computer Services Company.

- Database producers or publishers are the organizations responsible for the creation, processing and updating of databases in electronic form, using information supplied by the providers. A wide variety of organizations produce databases, including government agencies, research firms, universities, print publishers, financial institutions and information wholesalers. In the United States, many major print publishers, like McGraw-Hill and the New York Times, have also become major publishers of electronic databases. In Canada, The Globe and Mail and Southam News have followed suit with their Info Globe and Infomart services.

- Database retailers store data and information bases created by others or themselves on their host computers and provide access links through computer terminals, software and communications services to subscribers. The best-known Canadian vendor is I.P. Sharp Associates, a world-class computer time-sharing firm that distributes over 100 electronic databases concentrating on economic indicators and that operates in 20 countries around the world. Major U.S. database distributors include DIALOG Information Services (a subsidiary of the Lockheed Corporation), Dow Jones News/Retrieval and CompuServe (the two U.S. business information vendors with the largest number of subscribers), and Mead Data Central, which dominates the market for online legal information services. A similar service is offered in Canada by QL Systems.

These distinctions are not hard and fast. The database industry is evolving rapidly and a wide variety of relationships, formal or informal, is possible between the information providers and the database producers, and also between the database producers and vendors. In recent years, a trend toward mergers and consolidations has been discernible in this area as the major print publishers turn to electronic publishing as a key growth market and try to create their own distribution channels. McGraw-Hill, for example, acquired Data Resources and the *Reader's Digest* acquired The Source several years ago. Most recently, Reuters, the news giant which has turned to electronic information retrieval and transactional services in a major way, purchased I.P. Sharp.

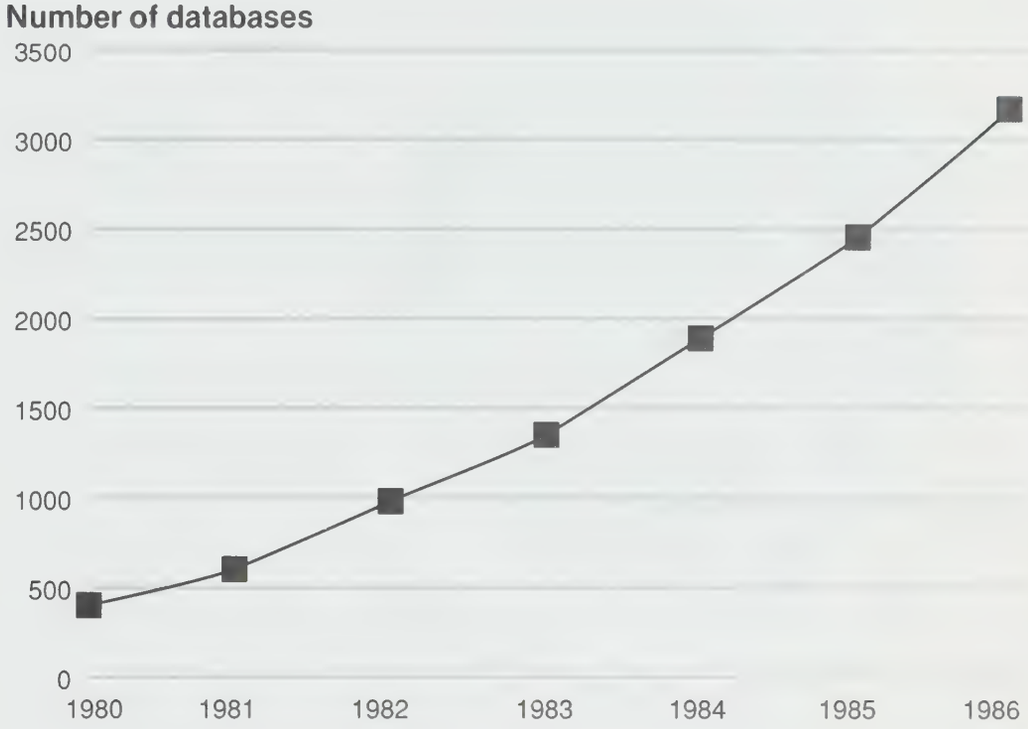


The database industry is evolving rapidly and a wide variety of relationships, formal or informal, is possible . . .

A number of large companies, whose primary business is not the distribution and sale of information, have also entered the field. Computer time-sharing companies with national and international data networks see themselves in the role of database retailers. Telephone companies can also participate, either by providing access to electronic directories and Yellow Pages, or by acting as a common access route, or "gateway" to other database vendors. The iNET 2000 service, offered by Telecom Canada, is a successful example of a gateway service. It offers access to the products of over 20 independent database vendors who provide information on everything from agriculture to marketing. Similarly, private and public institutions, which create large volumes of data for internal use, may choose to sell this data to third parties, either directly or through database publishers and vendors. For example, the online flight information data of airlines has become an essential worktool of travel agents. In the same vein, the CANSIM database, originally created by Statistics Canada for its own operational use, has now become the primary vehicle by which Statistics Canada distributes information in electronic form to users.

The increasing importance of electronic databases is best illustrated by the growth in the availability of publicly or commercially accessible electronic databases around the world. In 1979, there were 400 such databases, produced by 221 database producers and distributed by 59 online service vendors. By 1986, there were more than 3,000 such databases, produced by some 1,500 database producers. Online access was provided by some 450 service vendors, with 50 gateway firms or distributors providing access to a number of vendors.

CHART 5
WORLD-WIDE GROWTH IN ONLINE DATABASES

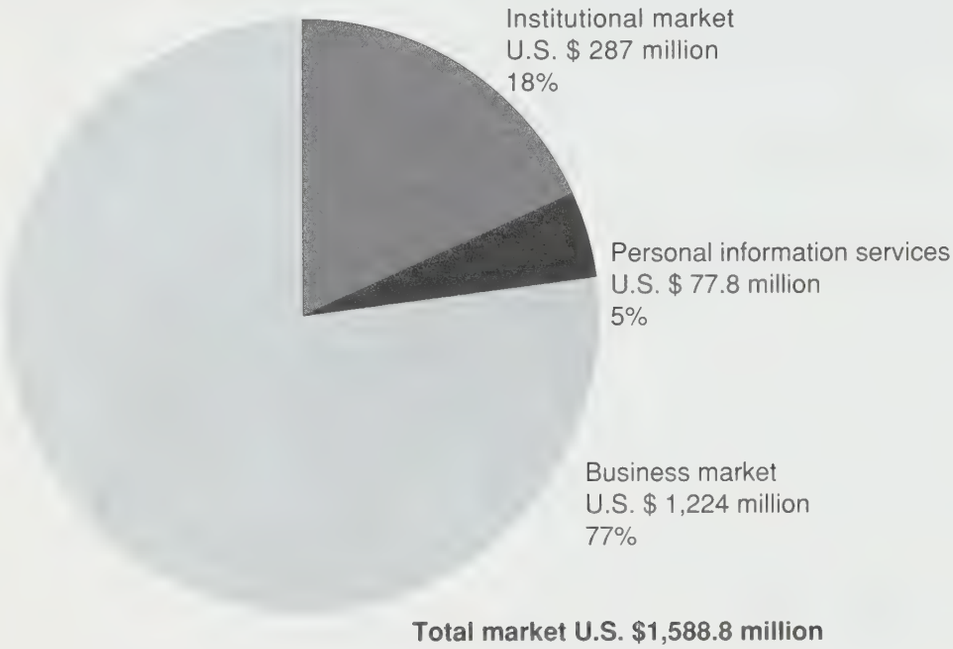


Source: Cuadra/Elsevier, Directory of Online Databases

The United States is clearly the world leader in the database industry. U.S. database producers and vendors constitute over half the total in both the online and gateway categories. According to an IDC/LINK study, sales in the United States of commercially-available information delivered in electronic form accounted for nearly U.S.$1.6 billion in user expenditures in 1984. This market is expected to reach almost U.S.$3.6 billion in 1989, a compound annual growth rate of 17.8 percent, which is much higher than the growth rate for printed products in both the United States and Canada.

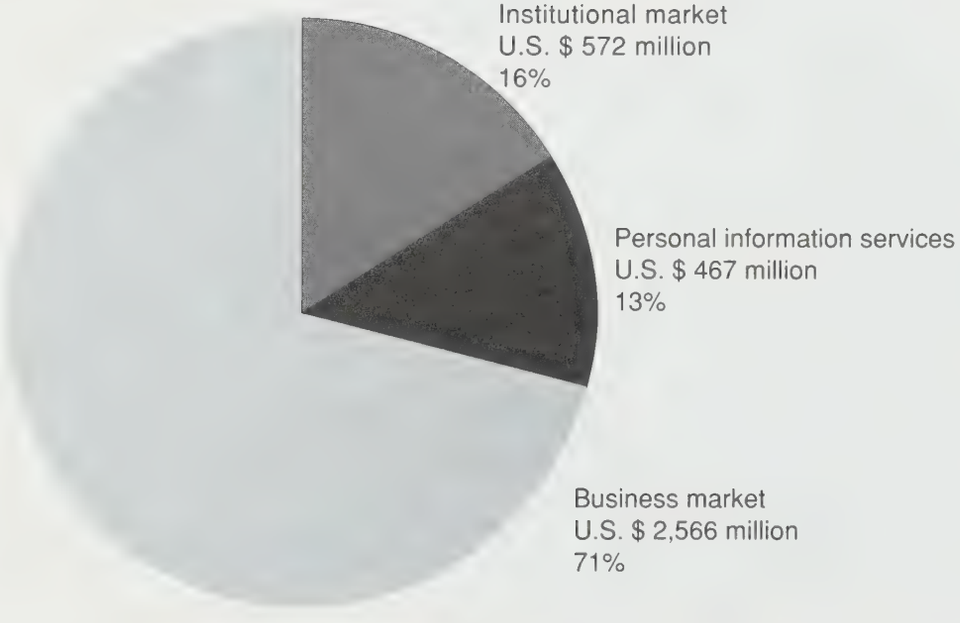
Business and institutional users account for the lion's share of this market, and will continue to do so over the next 5 to 10 years. In many cases these business databases are substitutes for information contained in print media, such as newspapers, magazines and journals. U.S. businesses and institutions are prepared to pay a premium price for rapid access and search capabilities.

CHART 6
U.S. ELECTRONIC INFORMATION INDUSTRY REVENUES 1984



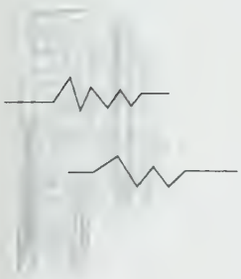
Total market U.S. $1,588.8 million

CHART 7
PROJECTED 1989



Total market U.S. $3,605 million

Source: Link Resources



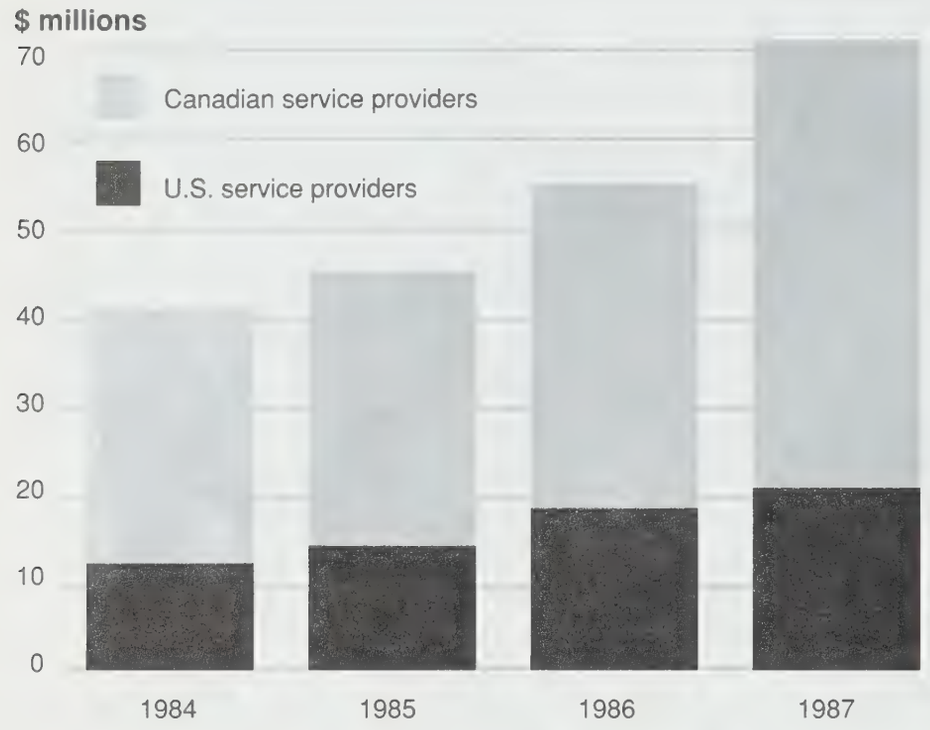
Bell Canada has announced a market trial of a . . . service called Alex . . .

Consumer information services, such as teleshopping, sports news, hobby information and electronic bulletin boards, accounted for $77.8 million, or 5 percent of the total in 1984; this is expected to increase rapidly to some $470 million or 13 percent by 1989.

In spite of the predominance of business and institutional demand, a number of U.S. firms have also pursued the consumer information services market. The most successful firms to date are CompuServe, Dow Jones News/Retrieval and The Source. The first two now have over 250,000 subscribers and the last some 60,000.

By far the most successful consumer information service in the world is the Télétel service of the Direction générale des télécommunications (DGT), a unit of the French ministry of Postes et Télécommunications, which now has over two and a half million subscribers. The service is accessed via a cheap, easy-to-use video terminal called Minitel, which the DGT provided to residential subscribers on condition that they gave up using printed telephone directories and switched to the exclusive use of electronic directories. The Télétel service acts as a gateway providing access to thousands of databases and transactional services provided by entrepreneurs. Currently there are over 1,000 databases for public use, including news services, electronic shopping, electronic games and electronic mail. More than 1,000 other databases are available to corporations for business-related functions. Bell Canada has announced a market trial of a similar service called Alex which will use Canadian technology. It is scheduled to start in 1988 in the Montreal area and will test whether a Télétel-like service would be as successful in a Canadian communications environment where social and commercial characteristics are quite different from those in France.

CHART 8
CANADIAN DATABASE MARKET ESTIMATED SHARES

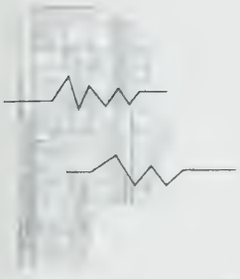


Source: Evans Research

Information on the size, growth and structure of electronic database markets outside the United States is limited. No reliable information on Canadian user expenditures is available, but on the supply side, the Canadian database industry appears to be significantly underdeveloped in relation to that of the United States, particularly in the area of database publishing. Recent estimates suggest that revenues to Canadian vendors from electronic database publishing will be only $30-50 million in 1987, just 2 percent of the U.S. market.

The strength of the U.S. industry stems from two sources. First, the United States creates more information than any other country. Second, large and well established U.S. print publishers, like McGraw-Hill, Prentice-Hall and Dow Jones, have moved decisively into the electronic publishing field. Originally, they introduced electronic technology to automate the print publishing process in order to reduce costs and improve the quality and timeliness of their products. As a result of this

. . . on the supply side, the Canadian database industry appears to be significantly underdeveloped . . .



In Canada, one of our fundamental challenges as a country has been to ensure that we balance two often conflicting objectives.

process, almost all their information is held in electronic form. This allows the publisher to repackage the same information and retail it in a variety of ways including books, newspapers and magazines, as well as through online databases and compact discs. These companies see their highest growth potential stemming from this new market for electronic information products.

In Canada, one of our fundamental challenges as a country has been to ensure that we balance two often conflicting objectives. The first is to guarantee free and open markets for information and information products from all over the world, to ensure business efficiency, meet academic requirements and provide a lively cultural life. The second is to ensure that there is a healthy supply of distinctive Canadian materials in market segments that directly affect Canadian identity — in particular, those that publish materials relating to Canadian education and culture. For the traditional information industries, this has often involved the use of subsidies and other support measures to make up for the "thinness" of the domestic Canadian markets. In recognition of the fact that the production of uneconomic but culturally significant products may also be supported by the profits of commercial publishing activities, it has also required efforts to ensure a strong Canadian presence in the publishing business.

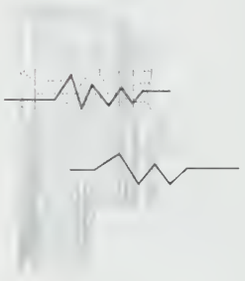
As a result of these measures, Canadian governments have succeeded in nurturing an increasingly vigorous Canadian print publishing industry. However, none of our firms can match the financial or technical muscle of their major U.S. counterparts, and there are real questions as to whether they will be able to follow them into the new field of publishing information electronically. As noted above, technology is also making it possible for new players to enter the publishing field either from closely related industries such as electronic data processing or from very different business backgrounds. As this becomes an increasingly important market segment, there is a danger that the Canadian industry will be left behind and that in a few years time we will find ourselves in a similar situation with respect to these new products as we did in traditional publishing 10 or 15 years ago.

A key issue in devising a strategy for Canada in the information age is how best to ensure the development of a vibrant Canadian database industry. It will be increasingly central to the development of our cultural, political and commercial life as a country.

One alternative is to see the database industry primarily as an extension of the traditional publishing industry and to attempt to support it with the same kind of measures that have proven effective in this field. Clearly this approach is valid in areas of cultural concern. In other market segments, however, it is an open question as to whether a culturally-based approach is appropriate, or whether a market-driven strategy which might emphasize the free flow of information and seek to build on Canada's strengths in telecommunications and data-processing services, would be more effective.

Whichever option, or combination of options, is deemed the more appropriate, there is clearly a need to address this issue since the Canadian industry appears to be underdeveloped compared to some of its foreign competitors.

This is a relatively new industry but we need to develop a national consensus now on the measures that may be required to ensure its future vitality.



. . . we need to develop a national consensus now on the measures that may be required to ensure its future vitality.

Software

Software comprises the instructions that direct the operation of a computer. The set of instructions required to make a computer perform a particular procedure or function is called a program.

Software occupies a special place among the new information products. By directing the operation of both technical devices and networks it makes it possible to create new messages and information products and to store, exchange and retrieve them. In this sense it is a medium. But software can also contain embedded content, for example, in the form of a game or an electronic textbook. In this sense it is a message or an information product.

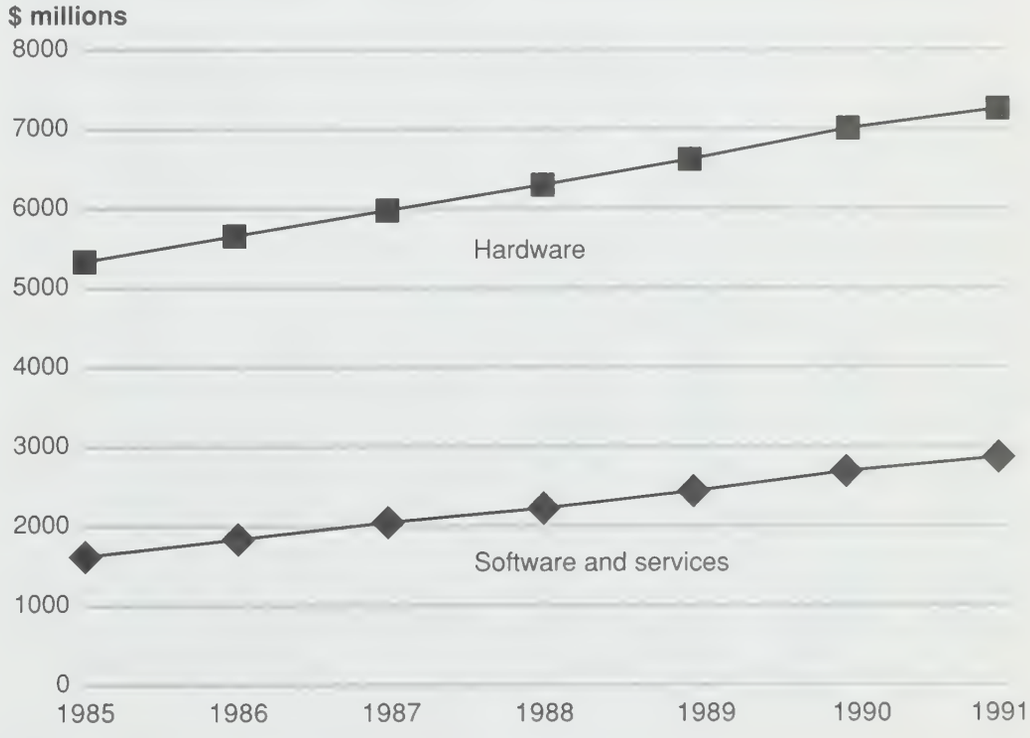
. . . software . . . may be the single most important commodity in ensuring future national economic success.

Today, software embodies the intelligence that drives all sectors of the information economy — from the systems that control the sizing and cutting of logs, to the robots that manufacture cars and industrial machinery, to the networks that manage global financial transactions round-the-clock. Because software represents the intelligence of the new information-based economy, it may be the single most important commodity in ensuring future national economic success.

The strategic role of software in information technology applications became more visible in the early 1980s. Most experts concluded that the spectacular advances in the hardware components of these technologies, mainly attributable to continuous technical and economic advances in semi-conductors and very large-scale integrated circuits, would have to be supplemented by more intelligent, user-friendly software to make them accessible to the majority of people.

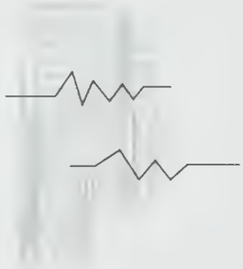
CHART 9

CANADIAN INFORMATION PROCESSING INDUSTRY REVENUES BREAKDOWN OF REVENUES



Source: International Data Corporation

The increasing importance of software in general, and packaged software in particular, is reflected in the financial performance of the Canadian information processing industry. According to IDC Canada Ltd., total 1985 revenues to the Canadian information processing industry equalled $6.9 billion, with $4.4 billion (63 percent) accounted for by hardware sales, $0.9 billion (14 percent) by hardware maintenance services and $1.6 billion (23 percent) by sales of software/services, which include data-processing services, professional services and packaged software. While revenues to the industry as a whole are predicted to grow at a compound annual rate of 6.3 percent between 1986 and 1991, the software/services sector during this same period is predicted to grow at a compound annual rate of 9.4 percent to $2.8 billion in 1991, increasing its contribution to total industry revenues from 23 percent to 28 percent.



Software falls essentially into two broad categories: systems and applications software.

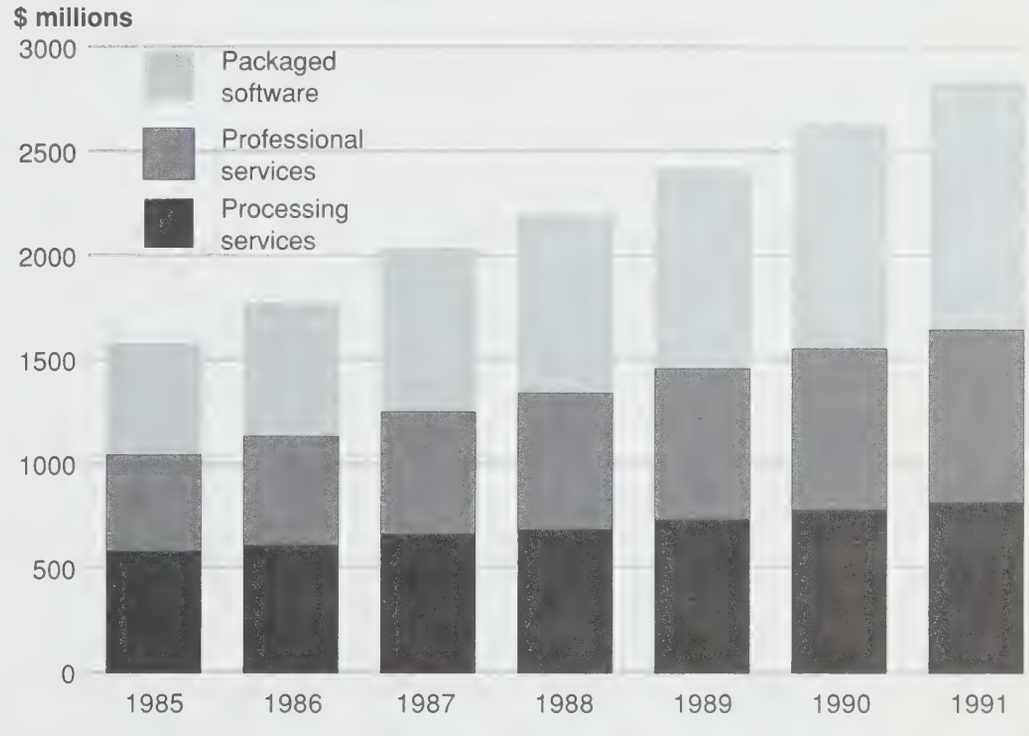
Software falls essentially into two broad categories: systems and applications software. Systems software refers to that programming which directs the fundamental operations of a computer. It includes the operating system, which may be different for each different type of mainframe computer, minicomputer, microcomputer, digital telecommunications switch or private office switch. Systems software determines the fundamental characteristics and capacities of telecommunications and computer systems. The systems software for a telecommunications switch, which is a special-purpose computer, is always sold with the hardware and produced by the equipment manufacturer. In the case of computer manufacturers, a certain amount of systems software, particularly the operating system of the computer, is also sold with the hardware because the latter cannot operate without it. The operating system is usually developed by the equipment manufacturer, but other types of systems software, like that used for sorting, merging and copying files, can be developed by independent software companies.

Applications software operates in conjunction with systems software by providing the necessary programming to undertake specific business management, education, entertainment or other applications. An applications program turns a general purpose computer into whatever tool is required to accomplish a specific task. With a word-processing package, a computer becomes a publishing plant; with a spreadsheet, a personal financial advisor; with a graphics program, an animation studio; with courseware, a tutor for your child. It is applications software that makes computers perform useful tasks.

In the cases of both systems software and applications software, the trend is toward the development of software "packages." This means that instead of hiring computer programmers to develop customized software for any particular use, most consumers are buying their software on a "packaged" or "off-the-shelf" basis. Not only is this radically reducing the cost of purchasing software, it is also spurring the development of a whole new software industry, made up of firms that produce software for mass-market consumption.

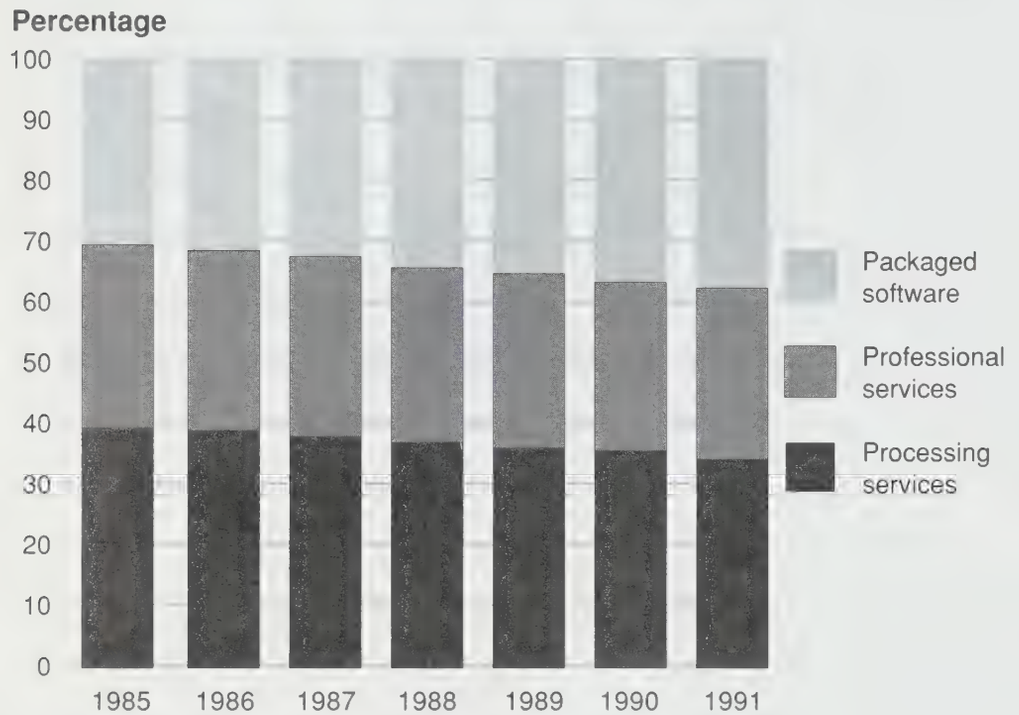
Although analogies are never perfect, this change in the nature of the business is not unlike the emergence of mass production in any other area. No longer are automobiles or books designed as unique objects; today they are produced on a standardized basis, radically reducing costs and increasing their accessibility. A similar trend is underway in the software area which will probably witness an increase in the influence of software "packagers."

CHART 10
CANADIAN SOFTWARE AND SERVICES REVENUE



Source: International Data Corporation

CHART 11
CANADIAN SOFTWARE AND SERVICES REVENUE

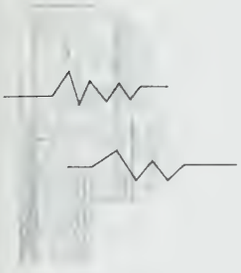


Source: International Data Corporation

Within the software industry itself, certain trends are critical. Revenues from packaged software are predicted to grow from $530 million in 1985 to $1.2 billion in 1991, with a compound annual growth rate of 13.5 percent, along with an increase in contribution to total software/services revenues from 33 percent in 1985 to 41 percent in 1991. This means that the projected growth rate for application packages and tools is significantly higher than that projected for the rest of the industry.

Canada has internationally-recognized skills in software development and general consulting, which stem both from the excellence of its education systems and extensive industry experience gained in a wide variety of customized user applications. Firms like Cognos, Systemhouse and DMR are considered world class players in their respective market segments. Their skills and those of other Canadian companies provide a strong foundation not only for excellence in systems integration, but also for the future development of artificial intelligence based expert systems which exhibit characteristics normally associated with humans, such as recognizing words and objects, translating from one

Canada has internationally-recognized skills in software development and general consulting . . .



. . . Canadian packaged software . . . is a public policy issue for reasons other than . . . economic ones.

language to another and diagnosing medical problems. This is likely to become a key area of activity over the next 5 to 10 years. Other related areas of Canadian expertise include computer-assisted translation and natural language processing.

While Canadian firms tend to occupy strong positions in the more mature data-processing and custom software markets, they are relatively weak in the growing packaged software market.

There appear to be a number of factors accounting for our relative weakness in packaged software. Although there are some significant exceptions, it seems clear that the majority of small and medium-sized Canadian software companies are poorly positioned to compete effectively in the packaged software market. Recent studies have stressed that they have difficulty in obtaining equity and loan capital, in part because of their perceived shortcomings in marketing and management. These companies tend to be technically oriented with strong software development capabilities, but are often weak in their general management and marketing capabilities, as well as their knowledge of the packaged software market, which is both crowded and highly competitive. Due to the conservative nature of the Canadian capital markets and banking industry, these firms usually have difficulty in raising sizeable amounts of either venture capital or loans. There is a real question of their continued capacity to compete against the large multinational companies now dominating this market, particularly in segments where access to retail distribution channels is a critical factor.

Independent Canadian packaged software activity is a public policy issue for reasons other than purely economic ones. Even if software market conditions were generally favourable, many needs in special social and cultural priority areas might not be met due to the small Canadian market size and the high risks associated with these markets. Two examples illustrate this situation.

Francophone users in Quebec and elsewhere in Canada have very few French-language products to choose from. As we become an information society, the ability of all Canadians to participate in its development and share in its rewards will depend on having access to essential tools of work and leisure in their preferred official language. Although some foreign-based multinationals are beginning to offer French-language software products, special support will likely be required to make the development of a broad range of French-language software geared to the particular needs of Canadian users commercially viable.

Francophone users in Quebec and elsewhere in Canada have very few French-language products to choose from.

Domestic educational courseware has difficulty matching the unit price of foreign products, which have captured roughly 90 percent of the elementary and secondary school market. Governments at the federal and provincial levels continue to be concerned with ensuring the availability of textbooks that reflect Canada's linguistic and cultural heritage. As software becomes an increasingly important element of the education system, it will be essential to ensure Canadian products are available.

Canada cannot afford not to have a lively and vigorous software industry. Like the database industry, it will be central to our economic, social and cultural life. We must begin a national discussion now on what measures should be taken to ensure the future vitality of the industry. In approaching the development of this policy we must ensure that it is established quickly, since other countries are already developing national strategies.

We must begin a national discussion now on what measures should be taken to ensure the future vitality of the industry.

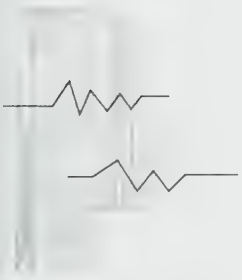
Toward an agenda

Electronic information products are very new. Electronic database providers and software publishers only began to develop over the past 15 years, and most of their growth has occurred in the last five. These products currently take up a relatively small share of the total information market, under 5 percent, but the demand for such products is expected to grow at a much faster rate than that for conventional information products such as newspapers, magazines, books and films.

The new electronic information shares in common with its traditional counterpart the fact that it is ideas that are being sold. As such, it is important not only for the contribution it makes to our economic life, but also because of its impact on our cultural life and on our identity as a country. It will be as central to ourselves as a people as the books, magazines, newspapers and television programs that now constitute the lifeblood of our national identity.

As noted earlier, conventional publishers are increasingly entering the database and software industries in other countries. For their part, the primary components of these new industries most closely resemble those of publishing. For both the database and software industry we are beginning to see the emergence of discernible and distinct components focussing on producing the work (writing), publishing the work (buying the rights and marketing) and distributing it in a way that parallels the traditional structure of the publishing industry.

Not surprisingly perhaps, when it comes to protecting the value of these new information products, they are treated much like the traditional ones. The Government of Canada has already tabled legislation providing copyright protection for software products; they will be treated under the new act as literary works. In this sense, they share with their more traditional counterparts the fact that it is not the physical objects themselves that have value (that is, the paper in the book or the plastic in the floppy disc), but the ideas they contain.



But to secure our position, it will be essential to address some potentially dangerous weaknesses.

There is no reason why Canada should not be strong in these industries. It already has significant strengths in software, and world class university facilities for the training of programmers and software engineers. But to secure our position, it will be essential to address some potentially dangerous weaknesses.

- We must significantly strengthen our database industry which appears to be growing more slowly than its foreign competitors.

- We must ensure the future vitality of the packaged software industry. Evidence suggests that this sector will be the fastest growing part of the industry in the future. Our domestic companies are expe-riencing increased difficulty competing and appear to be badly underfinanced.

If these two problems are addressed effectively there is every reason to suppose that the new electronic industries will develop vigorously. If they are not addressed, the danger is that we will find ourselves playing catch-up with our foreign competitors, a game that is extremely difficult to win.

While Canadians will continue to benefit from software developed in other countries, our ability to apply technology to unique Canadian needs and to develop new information industries that reflect our economic, social and cultural realities will depend on having a healthy software industry in Canada. Just as civil, mechanical and electrical engineering skills were essential to Canada's growth as an industrial nation, so we will need software design, engineering and production skills to prosper in the information age.

4
EMERGING NETWORKS

The changing relationship between the medium and the message

t was Marshall McLuhan, a Canadian, who drew the attention of the world to the fact that the medium of communications determines what kind of message can be conveyed. It is impossible, for example, to separate the development of electronic voice communications, moving pictures and broadcasting from the development of telephone, radio, coaxial cable and satellite communications networks. In the past, each medium provided opportunities for conveying certain kinds of messages and products and not others. As a result, they evolved to play unique but complementary roles in society.

Advanced telecommunications networks are essential for the movement of information in modern economies. At the same time as information plays an increasingly important role in everyday economic and social activity, the public increasingly relies on efficient telecommunications for access to information-based services. In the future we can expect that a further evolution of telecommunications networks and services will fuel economic and social growth in Canada and other countries. In these emerging networks, as we shall see, the relationship between media and messages will become much more complicated than formerly. This changed relationship raises important questions for the future structure of the telecommunications industry, as well as for telecommunications policy and regulation.

Telecommunications: a history of Canadian achievements

Canada has an impressive record of achievement in telecommunications. Perhaps the greatest contribution by a Canadian to telecommunications was made by Alexander Graham Bell who invented the telephone in Brantford, Ontario in 1884. Guglielmo Marconi received the first transatlantic radio signal at St. John's, Newfoundland in 1901, and since that time, Canadians have pioneered developments in radio communications. In addition, Canada is a leader in technology for digital switching and transmission systems.

Canada has an impressive record of achievement in telecommunications.

Today, we enjoy one of the world's finest telecommunications systems which is made up of the following components:

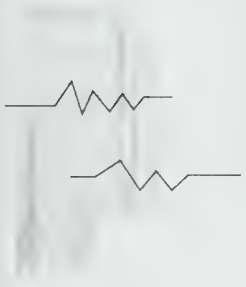
- Telecom Canada, an unincorporated association of the major telephone companies in Canada. Bell Canada is the largest of these companies, serving 60 percent of Canadian telephone subscribers; separate companies operate in the western and Atlantic provinces. In 1932, these companies came together to form a coast-to-coast telephone network. Today, the revenues of Canada's telephone companies are about $10 billion annually, and they offer an extensive range of voice and data services.

- Telesat Canada, the national satellite carrier incorporated in 1969. In 1973 it established the world's first domestic geostationary satellite communications system, Anik A. Today, Telesat owns five satellites which provide 96 channels of service, and derives its revenues equally from broadcasting and telecommunications. Telesat is jointly owned by the federal government and the major telecommunications carriers.

- CNCP Telecommunications, developed from the telegraph business of the railways in the nineteenth century. Although for many decades telegrams were the mainstay of the telegraph companies, diversification began over 50 years ago with the transmission of radio broadcasts, weather reports and air traffic control information. Following World War II, private wire, telex and microwave services were added. Today, CNCP provides a wide range of voice and data business communications services.

- Cable companies, providing television service to over 60 percent of the Canadian population. They are becoming increasingly active in a range of new services. As operators of local distribution systems, they constitute an important component of Canada's infrastructure for the movement of programs and information.

- Teleglobe Canada provides Canada-overseas telecommunications services through a combination of undersea cable and satellite facilities. It is the successor to the Canadian Overseas Telecommunications Corporation which was established as a Crown corporation in 1949. In 1987, the federal government sold Teleglobe Canada to private interests.

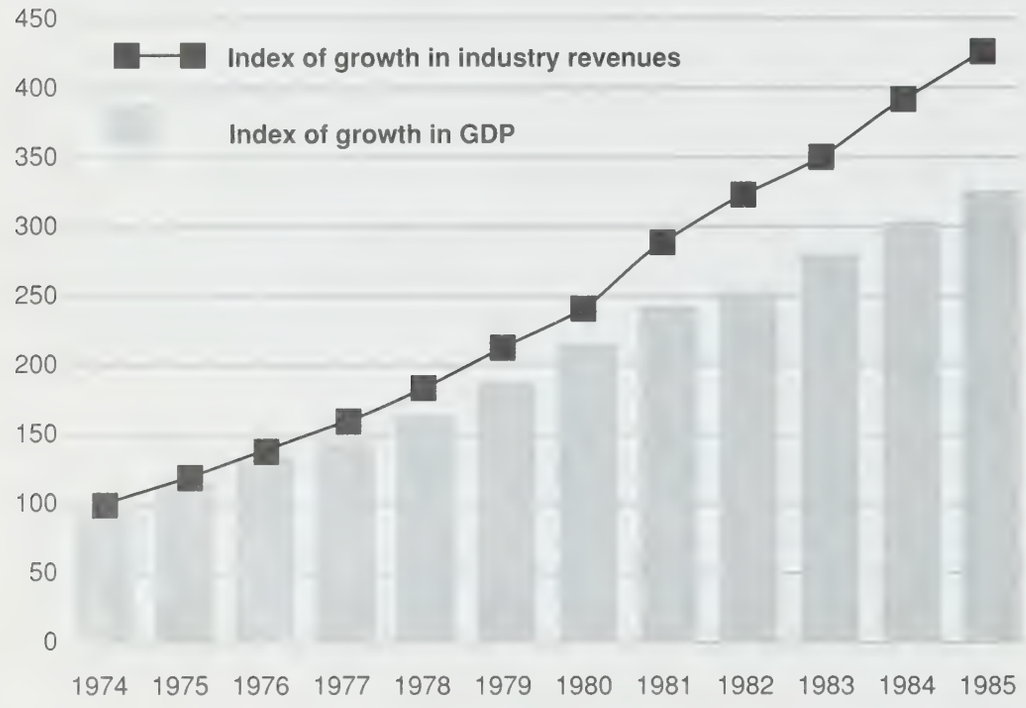


In addition, Canada is a leader in technology for digital switching and transmission systems.

Collectively, these companies constitute the network infrastructure of the Canadian telecommunications system. We are now a world leader in the penetration of telephones in the residential sector (98.2 percent in 1985) and we have a history of making more phone calls per capita (1,361 in 1985) than any other nation. Canada also has one of the highest penetrations of cable television in the world. As well as being served by two national telecommunications microwave transmission networks and a domestic satellite system, two suppliers of public data networks provide a wide range of services to Canadians from coast to coast.

The services offered by these networks are central to Canada's economic and social development. As Chart 12 illustrates, demand for them has increased significantly faster than our GDP, reflecting the increasing demand for information throughout the economy.

CHART 12
TELECOMMUNICATIONS SERVICES INDUSTRY



Note:
- telecommunications services: local and toll telephone service and other telecommunications services (includes CNCP, Teleglobe and Telesat);
- 1974 = 100; indices based on revenues measured in current dollars by Statistics Canada.

More and more, these networks are constituting the new infrastructure of the economy. They are already central to the movement of all types of information to all parts of the country. And there is every reason to expect that they will continue to grow faster than the GDP. This growth is being fuelled by the rapid expansion of data communications services. The market for these services is expected to grow at close to 30 percent a year over the next few years.

CHART 13
DATA COMMUNICATIONS MARKET IN CANADA

	(C$ millions) 1985-1989					
	1985	1986	1987	1988	1989	CAGR*
Public data networks	250	313	391	488	610	25%
Enhanced services	12	32	46	65	85	63%
Electronic mail	10	12	14	17	20	19%
Facsimile	39	58	81	113	153	41%
Other	45	60	80	110	150	35%
Total	356	475	612	793	1018	30%

***CAGR — Cumulative Annual Growth Rate**

Source: Evans Research
July, 1986

The emergence of the new information products described in the previous chapter and the speed of their diffusion will also depend on the quality and flexibility of the telecommunications infrastructure. The sophistication of the networks, their geographical distribution, access to them and the regulatory regime that governs their operations will determine the structure not only of communications markets, but of markets for all goods and services.

Evolution of the networks

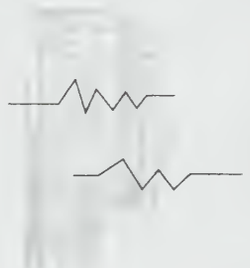
More and more, these networks are constituting the new infrastructure of the economy.

Over the last 20 years, we have witnessed an extraordinary improvement in the technology underlying the telecommunications industry. Advances have followed one another with breathtaking rapidity. Most of these developments have been based on the emergence of microelectronics, making it possible to embed computer power throughout the network. Now all parts of the network can interact intelligently from central office switches, to local distribution plant, to terminals themselves.

The result is that the various networks are now able to handle traffic that was previously the monopoly preserve of others. So, for example, the telephone companies can carry telex record messages that were historically the exclusive preserve of the telegraph companies. For their part, the telegraph companies now have the ability to carry long-distance voice messages, which has traditionally been a telephone company monopoly. The same has occurred between satellite and terrestrial services. Telesat — like CNCP — can offer long-distance voice, data and record message services in competition with both the telephone companies and CNCP.

These technological developments are blurring the boundaries that previously separated these different companies. This has in turn raised a host of regulatory and economic questions about where to draw the lines separating the different markets being served by them. To what extent should the satellite and telegraph companies be allowed to compete in the voice business with the telephone companies? What will be the economic and social consequences of different levels of competition?

Without going into these questions here — they are discussed in more detail later — it is important to note that this boundary problem will continue to grow. In future, however, the technology will not only permit the various networks to enter each other's business, it will also allow completely new services to emerge that will challenge even more fundamental boundaries.



The key to many of these developments is the digitization of the public telephone network.

The key to many of these developments is the digitization of the public telephone network which has been given high priority since the mid-1970s. Essentially, "digitization" means that messages are coded for transmission in the digital language of computers — as a series of zeros and ones — instead of in waves, or analogue form. This development means that it is possible to fully integrate traditional data processing and communications activities, with the aforementioned result that it is becoming harder and harder to distinguish between computing and telecommunications.

The importance of this development cannot be overstated, since it means that all parts of the network — telephone transmission systems, computers, switches, and television sets — are merging into a single unified machine. The faster this development takes place in any particular country, the better its infrastructure will be, and the better it will be able to compete.

Fortunately, Canada is moving to full digitization of the national communications network faster than any other industrialized country.

Fortunately, Canada is moving to full digitization of the national communications network faster than any other industrialized country. It is projected that by the late 1980s more than 70 percent of our intercity circuits will be carried on digital transmission facilities and that 80 percent of our local and long-distance calls will be digitally switched.

This high level of digitization will also place Canada in an especially favourable position in the evolution of an Integrated Services Digital Network (ISDN) — a goal strived for by telecommunications authorities in many industrialized nations.

ISDN is a set of agreed-upon international standards for allowing public telephone networks to accommodate a wide range of voice, data and video services. It is designed to permit conventional telephone lines to carry all manner of information. It would allow users not only to carry on conversations but also to exchange printed matter and graphic information at the same time. For example, using the basic ISDN copper service, a customer could simultaneously place a telephone call, establish a high-speed data communications link, and exchange packet data information through a third channel.

The move towards ISDN is being complemented by the development of Open Systems Interconnection (OSI) standards and protocols, which are designed to permit all computers to talk to each other. Incompatibility between computers has been an obstacle to the growth of computer-based communication services. By eliminating barriers to communications between different machines and networks, OSI and ISDN will usher in a new era of information access and exchange.

ISDN is a set of agreed-upon international standards . . .

The first phase of ISDN, based on current copper distribution technology, will provide economic advantages, facilitate the introduction of new services and permit the more efficient operation of telecommunications networks. But it is in the second phase, with the installation of optical fibres, that the real impact of ISDN will be felt.

Instead of the electro-magnetic waves or pulses used in copper wires, optical fibres use light to carry information. They are capable of carrying much greater amounts of information than either telephone wires or coaxial cables.

CHART 14
COMPARISON OF TRANSMISSION CAPACITY

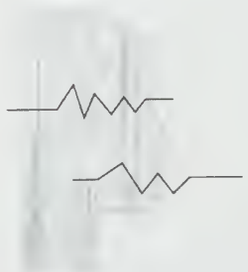
	Number of voice channels
Telephone wire	1 to 24
Coaxial cable	1,000
Fibre optic cable	10,000

Using optical fibres, it will be possible to provide "broadband" services — which might include cable television — over telephone lines. Equally, if the necessary switching capabilities were put in place, cable companies could offer telephone and switched data services.

Fibre optic based ISDN networks will permit users to access electronic information services using a single wire. In principle it will be possible, for example, to plug a television set, a burglar alarm, a computer and a telephone into the same wall socket and obtain service.

This in turn will make it possible to develop a range of new services for businesses and consumers: pay-as-you-view television which allows subscribers to dial up the movies they want instead of going to a cinema or video store; postal services that provide voice messages and pictures attached to printed text; interactive media that provide users with a "common visual space" where they can work together on architectural plans, engineering designs and other graphic representations. With broadband ISDN, new media and information services will no longer be limited by technology; they will be constrained only by human imagination and market demand.

In the Canadian telephone system, fibre optics are widely used in intercity trunks where large numbers of circuits are needed. They are also extensively used in large metropolitan centres to provide circuits between local exchanges with high growth rates and cable duct congestion. For local distribution applications, fibre optic technology is being applied selectively — particularly to serve urban business cores and large office complexes. The replacement of the copper wires that currently service individual residences by optical fibre cable is likely to be gradual because of the large investment in existing facilities and the continuing suitability of copper for many advanced telecommunications services.



The development of these new technologies is not restricted to telephone companies.

The development of these new technologies is not restricted to telephone companies. CNCP is also installing fibre and developing ISDN-based network capacities. This means that they — like telephone companies — will be in a position to offer a full range of new telecommunications services.

These developments will further blur the boundaries between different companies and market segments. When telephone companies can offer "broadband" services it will be technically possible for them to compete with cable companies; as the telegraph industry moves into fibre, it can compete with satellites to carry long-distance voice and picture traffic. These developments will increase the challenge to our traditional policies and regulatory arrangements.

Installation of new classes of networks is rapidly progressing.

The new networks and services

Technological developments are also permitting the creation of new networks, and the emergence of new uses for old ones.

- Installation of new classes of networks is rapidly progressing. One of these is cellular radio which uses the latest and most efficient digital communications technology for switching and for transmitting voice and data communications between users on the move — in cars, trucks, boats and trains — in urban, rural and remote areas. Cellular radio is interconnected with telephone systems and satellites to provide access to integrated voice and data networks on a national and international basis. It is now possible to phone anywhere in the world from a car, boat or plane as easily and efficiently as from home.

- Satellite networks are continuing to develop, and the demand for telephony, television broadcasting and data communications via satellite is expected to continue to increase over the coming decade. It is particularly important for Canada to ensure that rural and remote areas of the country can enjoy a diversity and choice of services roughly comparable to those available in urban centres. As part of these developments, Telesat plans to launch the world's first mobile communications satellite in the next few years. Among other things, this will extend cellular-style service to the whole country.

- Broadcasters are adding a number of data and "non-programming" services to their traditional offerings by using transmission capacity not required to deliver their conventional services. For example, they use the "vertical blanking interval" — the space just above the picture which is visible on a television screen — to carry a variety of new information services to residential and business subscribers. The captions that are inserted for the hearing-impaired are perhaps the best-known example.

- Cable operators are seeing their activities transformed. Already they are carrying one-way data services including news, financial quotes and weather information. Technology that would allow the cable companies to connect their networks with telephone companies networks to provide switched phone and data services, is now coming onto the market.

Broadcasters are adding a number of data and "non-programming" services to their traditional offerings . . .

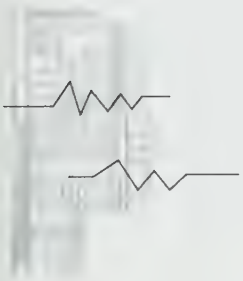
As well as transforming established telecommunications systems and permitting the development of entirely new networks, the merger of computers and communications makes possible the creation of completely new communications services. Such services are generally based on the use of computers to create, process and store information. These new services add value to the basic transmission component of telecommunications and are known as value-added networks (VANs).

Entry into the value-added business need not require the ownership of any transmission facilities. Unlike conventional telecommunications and broadcasting companies, value-added operators can provide their services simply by leasing transmission and switching capacity from established carriers instead of financing and building their own networks.

This makes it possible to create an open and competitive environment for the development of new services. It may also contribute to greater innovation, to the availability and variety of services, and to greater efficiency in the use of telecommunications services on the part of users and suppliers.

The variety of potential value-added services is considerable.

- **electronic mail**: messages composed on personal computers or specially designed telephone sets incorporating video screens and keyboards are "posted," either directly to other terminals or to "mailboxes" located in a central computer's memory;
- **voice mail**: spoken messages are recorded in digital code and stored in computer memory until they can be retrieved by the intended recipient;
- **graphics messaging**: pictures or diagrams composed on a computer can be exchanged during the course of a telephone conversation;
- **videoconferencing**: television transmission approaching broadcast quality is provided over telephone circuits much less expensively than over ordinary television channels;
- **electronic data interchange (EDI) services**: business users can exchange forms and documents in electronic form with considerable savings in time and money;
- **teleshopping services**: customers can window-shop through electronic "malls" using their personal computers and can purchase everything from candy and flowers to consumer electronics, sporting goods, major appliances and cars.
- **data-base services**: customers can browse through a wide variety of data-bases, using gateway networks, to assist them in accessing information on everything from stock market quotations and legal precedents to football scores and movie reviews.

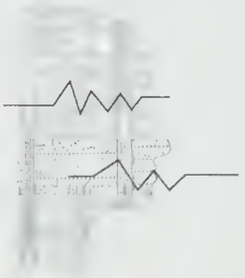


. . . the merger of computers and communications makes possible the creation of completely new communications services.

In these and other examples of value-added services, the computer power incorporated in these new networks adds value to the communications process by automatically performing functions which would otherwise require more costly or less efficient human intervention. Sending an office memo in paper form across the country, for example, is a less efficient alternative to electronic mail.

These services and others like them exemplify not only the convergence of computer and communications technology, but also the increasing difficulty of determining where the message ends and the medium begins. And this blurring of boundaries may — at the end of the day — raise the most complex and controversial regulatory and policy questions of all.

Interconnection



For the new networks, the most important form of interconnection is to the local distribution system of the telephone companies.

To facilitate the creation of these new networks and services it is essential that they be allowed to "interconnect" with the facilities of the established carriers. It is the only way that they can gain access to their potential customers without duplicating existing investments in plant and equipment. For the new networks, the most important form of interconnection is to the local distribution system of the telephone companies. This allows them to gain access to individual businesses and residences, without incurring the expenses involved in building a local distribution network, which will likely remain a "natural" monopoly for the foreseeable future.

To some degree, the interconnection of competing networks has existed in Canada for the better part of the past decade. Since 1979, for example, CNCP has used Bell Canada's and B.C. Tel's local telephone loops and switches to provide public data transmission across Canada through their national microwave networks. Without this form of interconnection CNCP would not be able to offer its voice and data services.

The same arrangements are essential for many of the services provided by Telesat Canada which must rely on the local telephone loops and switches of Bell and B.C. Tel to reach its customers. For its part, CANTEL, the supplier of mobile telephone services, is almost completely dependent on interconnection to reach the majority of its subscribers.

As interconnection erodes boundaries between traditionally separate industries and services, the fundamental policy question is how far it should be allowed to go. Or, to put it another way, how much competition should be allowed and how should we draw boundary lines between the different players? A particularly difficult question is whether interconnection should be permitted for companies that wish to offer long-distance voice services in competition with the telephone companies.

In Canada, as in most other countries, it has long been the practice to subsidize the provision of costly, but socially desirable local residential telephone service out of profitable business and long-distance services. In the emerging network environment described earlier, this situation creates demands in the business community for lower long-distance rates, particularly to help preserve the competitiveness of Canadian industry. It also offers incentives for new entry into the long-distance business through interconnection with telephone company facilities.

While large businesses and other heavy users of long-distance voice services might benefit if such interconnection was allowed, small business and residential subscribers might suffer if local telephone rates rose as a result of declining long-distance revenues.

Unless major changes in long-distance rates are made, these pressures to permit interconnection for long-distance voice services are sure to continue. Such pressures could be relieved to some extent by adjusting both local and long-distance telephone rates so that their prices more nearly reflected their costs. It is clear, however, that under either scenario, any move to cost-based pricing for long-distance service — either as a result of rate rebalancing or competitive pressures — could have a major impact on the prices charged for local telephone services.

At the same time that interconnection poses important questions, it offers enormous opportunities.

At the same time that interconnection poses important questions, it offers enormous opportunities. By interconnecting their networks, telecommunications companies can make their operations more flexible and efficient, and can offer new services without incurring significant new costs. In those parts of the country where interconnection has been achieved, the result has been greater competition, with more and better services available to business, without requiring major new capital expenditures to duplicate local facilities.

The policy challenge

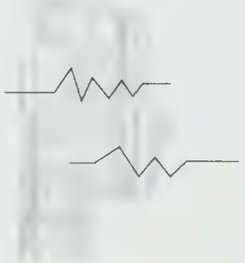
All of the industrialized countries, including the United States, Japan and those in Europe, are grappling with the policy and regulatory questions posed by the emergence of these new networks and their requirement for interconnection. They are struggling to determine what the rules should be, and all are asking themselves much the same questions: how many carriers should be allowed to enter the market? Under what conditions? With what obligations imposed on them? These are fundamentally questions of market structure.

As a means of accelerating innovation, the governments of Japan and the United Kingdom have privatized their state-owned monopolies and have licensed one or more competitors. The result has been a significant increase in the range of services available in both countries.

The United States, for its part, has gone even further. Whereas Japan and the United Kingdom have taken steps to increase competition in a limited, controlled fashion, the United States has abolished many of the rules and regulations inhibiting new entry while adopting new rules to make competition fair. Deregulation has triggered a considerable number of new services. It has also led to dramatic changes in local and long-distance rates. These changes have resulted in subscribers of local services paying considerably more (in the range of 20 percent between 1984-87) with long-distance rates declining by as much as 30 percent.

The telecommunications policy challenge now facing Canada is to create an environment which will spur new services without undermining our traditional commitment to universal basic service at affordable rates.

To address some of these issues, the Government of Canada released a major policy statement on July 22, 1987. It sought to clarify the rules of the new telecommunications game so that advanced and efficient telecommunications systems will continue to develop in the years to come. In doing so, it followed the evolutionary approach of Japan and the United Kingdom rather than the more radical U.S. line.



To address some of these issues, the Government of Canada released a major policy statement on July 22, 1987.

In essence, the new Canadian telecommunications policy distinguishes two types of carriers: those that own the basic infrastructure and those that use it to provide value-added services.

The first type (Class I carriers) includes all of the major existing owners of facilities, such as the telephone companies, CNCP, Telesat, and Teleglobe. The new policy makes clear that these carriers will be governed in the future by three key conditions:

- They must be at least 80 percent Canadian owned. Similar ownership rules exist in most other countries, including the United States, where it is recognized that telecommunications infrastructure is an essential component of national sovereignty.

- They must offer service if requested and make their facilities available for full interconnection with others.

- There will be limited entry for new Class I carriers. This parallels the approach of Japan and the United Kingdom, and recognizes that the economies of scale and scope prevalent in these networks are simply too great to support many suppliers. Even in the United States, with a market ten times that of Canada, deregulation had led to the emergence of only three major national carriers.

Class II carriers, on the other hand, include both value-added network suppliers (VANs) and resellers of authorized services. As noted earlier, they rent transmission capacity from established Class I carriers and then augment these facilities.

The federal government proposes to limit the restrictions on the operations of Class II carriers. There will be open and unrestricted entry in those markets and no limits will be placed on the entry of foreign suppliers. By creating an essentially open market in this way the Government hopes to stimulate the development of these new services.

The two different sets of rules governing the operation of Class I and Class II carriers are designed to recognize the differences in the nature and economics of their businesses. They are also designed to foster competition, while ensuring that the basic integrity of the Canadian telecommunications system is protected both from the point of view of local subscribers and of the sovereignty of the country. If the policy operates effectively, it will ensure that Canada remains at the leading edge of technological development in its most important area of high technology achievement.

This policy is, however, only the first step. While it provides an architecture for the regulation of intercity and interprovincial carriers and services, it does not deal with the issue of local distribution. Over the next few years this matter will have to be addressed as a major policy question.

This policy is, however, only the first step.

Although it was noted earlier that the local distribution network of telephone companies (the local loops and switches) is likely to remain a natural monopoly for the foreseeable future, technologies are emerging that challenge this premise. Cellular telephones are already bypassing parts of the local distribution system. In the future, local microwave systems may further erode the traditional telephone monopoly in this area.

More importantly, the emerging technology of fibre optics may challenge the boundaries that have traditionally separated cable television and telephony. One of the key issues facing the telecommunication industry is whether fibre optic cable will be made available to every household. If it is — and if it is put in by the telephone companies — it would then be able to carry all the television services currently offered by cable television companies using coaxial copper networks.

Alternatively, if cable companies were to upgrade their networks by installing fibre optics and developing switching capacity, they would be able to offer some of the services now being provided by telephone companies.

These questions are likely to take on greater urgency in the coming years. Some telephone companies in the United States are already installing fibre to individual households. In Japan, a major national commitment has been made to ensure that every home in the country is served with fibre by early in the next century. For their part, a number of European countries have evinced considerable interest in the development of switched-star network architectures that would allow cable companies to offer telephone service in addition to television.

These questions are likely to take on greater urgency in the coming years.

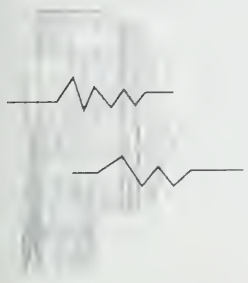
The challenge of local distribution will go to the heart of many complex economic and political questions. If other countries provide fibre to every home, can we afford not to? But if there is to be fibre to every home, do we have sufficient national resources to construct two parallel fibre-based networks, one for telephone companies and one for

cable television? If not, what should be the respective rules governing telephone and cable companies in implementing fibre optic delivery systems?

The resolution of these questions will determine the shape of the communications infrastructure of the information economy and with it our capacity to participate and compete in the development of new information services.

The federal-provincial challenge

The new national telecommunications policy cannot operate effectively unless it is implemented throughout the country. This can only be done with the co-operation and consent of the provinces, since regulatory responsibility for telecommunications has historically been split between the federal and provincial governments. The federal government regulates the dominant carriers in Ontario, Quebec, British Columbia and the two territories, while elsewhere the provinces regulate them.



. . . regulatory responsibility for telecommunications has historically been split between the federal and provincial governments.

Over the years, different approaches to telecommunications policy have been adopted by the federal government and those provinces that regulate telecommunications, largely in response to differing economic and social circumstances. The federally-regulated provinces with their relatively concentrated population and strong industrial bases, have been well served by private enterprise in the telecommunications sector. They have both required and demanded a significant degree of competition in the interests of economic efficiency and social innovation.

These same goals have been achieved through a very different approach in a number of other provinces. Private enterprise was singularly unsuccessful in serving the needs of the Prairie provinces, whose relatively small, dispersed populations were supported by resource-based industries. In response, they developed strong, provincially-owned monopolies which have provided high-quality basic telecommunications services to their populations and have also been world leaders in developing innovative technologies and services.

The challenge to the federal and provincial governments is to harmonize these different approaches with a view to ensuring that the benefits of universal service at affordable rates is maintained, while the development of new networks and value-added services is encouraged in all parts of the country.

In responding to this challenge, the federal government is particularly concerned that the current patchwork of rules and regulations means that there is not one national market in telecommunications, but a number of regional ones. Some of the resulting differences in customer access to equipment and services are illustrated in Chart 15.

CHART 15
ACCESS TO EQUIPMENT AND SERVICES

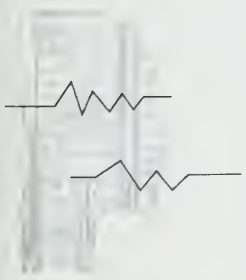
Competition/Interconnection	Where available
Attachment of customer-owned equipment to the network	Most, but not all provinces
Use of the telephone system to access CNCP for business services.	Federal jurisdiction only.
Use of CANTEL cellular services to access the telephone system	Some, but not all provinces
Use of the telephone system to access Telesat business services.	British Columbia, Alberta, Ontario, Quebec
Sharing the use of telecommunications services with others, or buying capacity in order to re-sell it to third parties.	Federal jurisdiction only

As a result of these differences, business people in areas under provincial jurisdiction are sometimes denied access to the range of service alternatives that are available in federal jurisdiction. Businesses in Ontario can purchase telephone switchboards from the supplier of their choice, but their counterparts in Saskatchewan cannot. Similarly, financial services firms in Quebec can choose between Telecom Canada's data networks and those of CNCP, while their counterparts in Manitoba and New Brunswick cannot. In the same vein, small businesses can combine to share transmission capacity in British Columbia to reduce their costs, while those in Newfoundland and Alberta cannot.

The danger is that this situation may inhibit the development of new services at the national level, particularly in the potentially high-growth area of VANs. Many new services cannot be supplied practically unless they are supplied on a national scale. There may be little point, for example, in incurring the costs involved in establishing new electronic mail services if the mail cannot be delivered in the Prairie or Atlantic regions. As well, there may be less incentive to establish costly new voice products if they can be sold in Montreal or Vancouver but not in Regina or Winnipeg.

This concern takes on a particular urgency as we move into freer trading arrangements around the world. The fragmentation of the relatively small Canadian market may inhibit the development of domestic suppliers of telecommunications services who could eventually move into international markets. Given the growing internationalization of the telecommunications and information services industries, it is particularly important that Canada build on its established telecommunications strength to create a strong presence in new networks and services.

While the federal government is naturally concerned with the integrity of the national telecommunications market, the provinces for their part wish to ensure that new services will be available to business and residential subscribers in all parts of the country and not only in those regions where markets are densest and therefore most profitable.



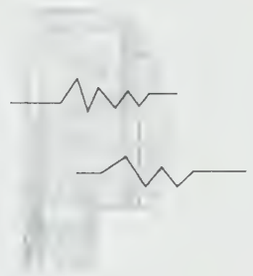
. . . it is important that Canada . . . create a strong presence in new networks and services.

Federal and provincial Ministers of Communications have recognized the urgency of dealing with these issues and have been working to resolve them. They met in Edmonton in April of 1987 and agreed in principle to a common set of policies as the foundation for the future regulation of the telecommunications system. It is this agreement and related policies that constitute the basis for the national telecommunications policy described previously.

Beyond agreeing on fundamental principles, it is important to clarify the roles of the provincial and federal governments in carrying out this new policy. In general, the federal government is of the view that it should exercise all of the powers required to ensure the integrity of the national market, while the provinces should retain responsibility for matters relating to activities carried out entirely within their borders.

In the past, the federal and provincial governments have worked side by side, each in its own fashion, to ensure that all regions of the country are equally well served by telecommunications networks and services. In the future, they must work together to devise common, compatible approaches to such fundamental issues as the interconnection of networks and the provision of value-added services in order to ensure that Canadian markets for information products and services function efficiently and effectively.

Without a strong national telecommunications policy supported by the federal and provincial governments, Canada runs the risk of never developing the electronic highways the country needs for the information age.



. . . the federal and provincial governments . . . must work together to devise common, compatible approaches . . .

5
USING COMMUNICATIONS TECHNOLOGY

The two previous chapters have looked at what is happening to messages and media as we move toward the information age.

Our principal findings have been two-fold:

- The range of messages and information products that can be created, exchanged, accessed and stored electronically is rapidly increasing. Today, it is technically possible to approximate and communicate almost any form of human perception, experience or expression through the new media.

- The barriers that have traditionally limited media to conveying certain kinds of messages are rapidly disappearing. Integrated services networks, capable of carrying voice, data, and image communications, are clearly the way of the future.

In the information age, any medium can carry any message.

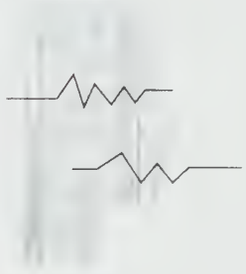
This fundamental change in the nature of communications is being driven by two sets of developments:

In the information age, any medium can carry any message.

- A rapid expansion of our physical capacity to store, process and transmit information in electronic form, resulting from the development, on the one hand, of larger communications "pipes" (such as fibre optic cables) and, on the other, of smaller and more powerful micro-electronic devices (such as very large scale integrated circuits).

- The development of more complex, sophisticated software which can take advantage of the expanding physical capacity of our communications system to instruct both the switches that control it and the terminals attached to it to perform an ever wider range of communications functions in ways that increasingly emulate, if they do not entirely replicate, human behaviour.

These developments are of momentous significance. Together, they promise to augment human intellectual and creative powers, just as electricity and the internal combustion engine multiplied our physical power during the industrial age. But this will only happen if we design the new media to serve human needs, purposes, desires and habits.



But this will only happen if we design the new media to serve human needs, purposes, desires and habits.

One of the principal challenges that lies ahead of us as a country is to ensure that Canadian individuals and businesses can use and apply communications and information technologies effectively to meet our own social and economic needs.

Meeting this challenge is a complex task. We are learning that these technologies cannot be applied successfully without a thorough understanding of both how the technology works and the multiple aspects of the environment in which it is being placed. Indeed, many observers believe that it is in the hybrid discipline of "socio-technical systems" — the study of technology applications in human settings where the most significant advances will be made. Some have started to distinguish applications from hardware and software development by calling it "people-ware."

In this chapter, we will highlight certain issues in the area of business and social applications and examine the central role communications and information technologies can play in reducing regional economic disparities. Although these issues are not the direct responsibility of Communications Canada, they will be integral to the development of media and messages over the next two decades, and thus to Canada's communications agenda.

Business

In the late 1970s many people confidently predicted that the fully-automated factory was around the corner. Through the use of advanced information technology, including robots, CAD/CAM, distributed process controls, and automated inventory controls, highly efficient factories would emerge employing no people at all.

However, the introduction of robotics and communications and computing technologies in manufacturing has been more difficult and complex than anticipated. For example, the main problem encountered by General Motors in its massive program to automate its factories is debugging the software that co-ordinates the robots. At the same time, because the various machines have incompatible ways of packaging and sending information, they cannot communicate with each other and only about 15 percent of them can exchange inventory or scheduling data, resulting in many isolated manufacturing cells or "islands of automation."

Numerous studies, including a recent survey by the Economic Council of Canada, have shown that automation is well advanced not only in North America but across all OECD countries, although certain hurdles remain to be overcome. The most obvious one is the high costs associated with the technology. The latest computerized manufacturing systems can cost tens of millions of dollars; few small or mid-sized companies can even consider the investment in such technology.

Other barriers are as important. Among them are organizational inertia, the scarcity of manufacturing engineers, and the lack of standards for communication between different types of shop-floor equipment. Furthermore, in some cases, automated factories have proven less efficient and productive than their less automated counterparts. Two factors that one might assume to be impeding progress — labour union opposition and the need for better technology — in fact play minor roles. But clearly the predictions regarding the advent of fully automated factory floors employing no people have not been realized.

Numerous studies . . . have shown that automation is well advanced . . .

Similar predictions were made about office automation. As in factories, there has clearly been progress. Perhaps the greatest success has been achieved in the banking and financial services industry which is rapidly moving toward computer and communications based systems for electronic funds transfer (EFT). In the United States, financial institutions already use EFT to transfer about 80 percent of all internal transactions. In Canada, the major chartered banks and investment houses are progressively adopting communications systems to move large amounts of money around quickly and efficiently.

Perhaps the greatest success has been achieved in the banking and financial services industry . . .

Examples of new types of electronically based financial services include point-of-sale authorization, automated teller machines, point-of-sale electronic funds transfer, and the provision of information and banking services electronically to business.

Impressive as these accomplishments are, they do not quite measure up to the enthusiasm of the late 1970s when it was widely believed that the paperless office was within reach. But as in manufacturing, the introduction of these technologies into the office environment has proven more difficult and complex than originally anticipated. Studies by Communications Canada through field trials indicated clearly that new information technology could not simply be dumped into offices. When that occurred, productivity and performance went down. It became very clear that there was insufficient understanding of how offices worked and what was required to make the technology useful.

In manufacturing as in office automation, the general problem seems to have been that new technologies were introduced without due regard for or even understanding of their relationship to the work environment and to the needs and capacities of the workers they were designed to complement. Indeed, the Economic Council stressed that the simple addition of a new piece of computer-based equipment on a production line, without adequate training of employees to exploit its fullest potential, results in few, if any, gains in quality or in efficiency of output.

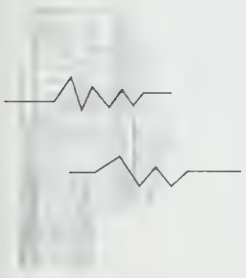
There is growing evidence that productivity is a management problem, not a technology question. As *Business Week* reported in its June 16, 1986 issue:

There is growing evidence that productivity is a management problem, not a technology question.

"Although Detroit's newest plants are at least as sophisticated as anything in Japan, the productivity at many of what were supposed to be the fanciest production showcases in the United States is way short of expectations. . . The carmakers are reluctant to discuss their problems in detail, but observers blame Detroit's woes with automation on its assumption that technology alone would solve all problems. 'They're now discovering that if you don't have good management, you'll end up with a rotten automated plant,' concludes David E. Coles, director of the University of Michigan's Office for the Study of Automotive Transportation."

For both office and process automation, the problem of applying the technology has been further compounded in Canada by the sluggishness with which business has adopted it. The Economic Council stated:

". . . we are lagging in comparison with other industrial nations, particularly the United States and Western Europe. Our message, therefore, is that Canadians must improve their performance with respect to the introduction and use of computer-based technologies. Failure to do so will lead to a loss of prosperity and jobs as Canada's competitive position deteriorates."



Canada's persistent lag in information technology diffusion is a serious problem of national proportions.

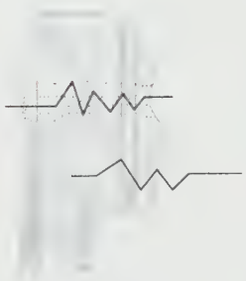
Canada's persistent lag in information technology diffusion is a serious problem of national proportions. The diffusion of these technologies is too slow. The capital investment needed for the introduction of advanced equipment is also lagging seriously. Without that spending, automation cannot take place. This message has been delivered repeatedly not only by the Economic Council, but by such private sector organizations as the Information Technology Association of Canada and the Canadian Advanced Technology Association.

The reasons for this, according to the latest work from the Economic Council, appear to relate to the nature of our culture itself. We do not have a culture that promotes the use of new technology. The achievements and progress brought about by science and technology generally, and certainly by communications and information technologies in particular, are not given high value, let alone recognition, by the public at large. Scientific and technological literacy in our school system is not strongly engrained.

As the Prime Minister pointed out recently, we need to become more technologically oriented as a country:

"Canada's traditional strength lies in its resources. We have done very well in developing our resources and we will continue to supply the world with Canadian fish, wheat, newsprint, food, iron ore and other products. . . Demand for our resources will not return to the heights of the 1970s because worldwide, people's needs for raw materials are changing and shortages have become surpluses. . . The challenges, as I see them, are to develop and apply science and technology to productivity and industrial innovation. . . The future lies in knowledge-intensive industries and new technological applications. . . . To change our output, we have to change our attitudes and our institutions. . . . In short, in this new age, we must compete with our brains, our ingenuity and our creativity."

The key issue for Canadians is to accelerate the rate of diffusion of technology. This will require the concerted efforts of many players in the federal and provincial governments, industry, universities and our social service institutions.



The key issue for Canadians is to accelerate the rate of diffusion of technology.

There are encouraging signs in all these quarters that Canadians are responding to this challenge. For example, the past year has seen the adoption of a national science and technology policy by the federal and provincial governments, a policy which accords a central priority to technology diffusion. It has also seen the launching at the federal and provincial levels of a number of consortia in key technology areas, uniting government, industry and the universities in common efforts to increase the speed of technological uptake in Canada.

It is clear, however, that these efforts will not bear fruit unless they are able to draw on the core resources of the information society: the new media and messages that are its lifeblood.

Social services

In many aspects of the field of health delivery, Canada has been a pioneer in the use of these technologies. The electronic delivery of health care services, including long-distance medical examinations and the remote monitoring and diagnosing of patients, is becoming a fact of life

In many aspects of the field of health delivery, Canada has been a pioneer in the use of these technologies.

in certain parts of Canada. Indeed, one of the major telecommunications carriers boasts that the infrastructure it currently owns is sophisticated enough to allow a doctor located in Vancouver to monitor the heartbeat of a patient in Whitehorse without static interference.

We have already mentioned the crucial work of the Memorial University Tele-Health Centre in remote delivery of health care. The following are other examples of what Canadians are doing in this field.

- The Canadian Hospital Association recently announced the creation of Infohealth, Canada's first nation-wide electronic network for communication and health information services. This service was designed to meet the needs of health service executives and health care professionals, as well as national and provincial health care organizations, by providing electronic access to various databases including Info Globe, iNet 2000, and MEDLARS, the database of the National Library of Medicine. Also included in this service is the ability to conduct computer conferences, allowing individuals and associations to share medical and administrative information quickly.

- In hospitals in Toronto, computer terminals are being placed alongside the beds of patients to replace medical charts. Doctors and nurses thus have instant access to the patient's complete medical history.

- In Manitoba, a program is currently being developed to improve the delivery of health care services in the province through the application of communications and information technologies. Under this project, electronic health care networks, including multi-vendor equipment, multi-organizational patient information, order and results reporting, local area networks in hospitals and health database services will be developed. The project also includes the creation of physician support systems, in particular expert systems in diagnostics, customized electronic mail and transaction transfer systems, cost control systems, service integration and service management systems, patient alarm systems and patient monitoring systems. The project also seeks to foster the development of computer-aided group purchasing systems, product/price information and interactive bidding/buying services for hospitals.

Access to health care and the efficiency of the infrastructure that delivers it will become an increasingly important issue in the future. As the population ages, demands for more and better services will increase.

These applications are particularly important to a country like Canada where the vastness of our geography and the dispersal of our population makes the delivery of uniform-quality health care to all Canadians a continuing challenge. We have become leaders in this field out of necessity.

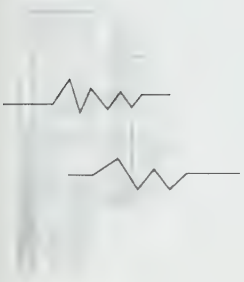
In the area of education, Canada also has an enviable reputation. As noted in Chapter II, we are pioneers in educational broadcasting and tele-education. Examples of our leadership in this area abound.

- Mount Saint Vincent University (MSVU) in Halifax operates the Distance University Education via Television (DUET) system. The DUET program uses a studio-equipped classroom to transmit live, interactive credit and non-credit courses by television to distant learners. The courses are transmitted to a local urban clientele via the Halifax and Dartmouth cable systems. For more distant learners spread out over all four Atlantic provinces, the courses are carried on the Atlantic Educational Television Service along with educational programming from other universities and the Atlantic departments of education on the Atlantic Satellite Network.

- L'Université de Moncton has been involved in audio-teleconferencing since 1983, when courses were first offered to students in locations such as Shippegan and St. Louis de Kent, New Brunswick. Moncton has also entered into an agreement with the University of Ottawa for courses originating in Ottawa to be received by teleconference at various New Brunswick locations.

- In Nova Scotia, the largest network is the Computer-Assisted Design/Computer-Assisted Manufacturing (CAD/CAM) network at the Technical University of Nova Scotia (TUNS). The network is intended to encourage design and manufacturing industries in the province to use CAD/CAM and related technologies in their production processes. As well, it is used for a number of computer services including: design, database access, and teaching. On-site users consist of 200 students and professors; off-campus users include private companies, universities, institutes, foundations and government departments.

In the area of education, Canada also has an enviable reputation.



Our expertise results from the dispersal of our population across the top half of the continent.

- The Western College of Veterinary Medicine (WCVM) of the University of Saskatchewan provides professional training for veterinarians in the four western provinces. Because of the nature of their profession, vets reside in widely dispersed geographic areas. This dispersion makes the provision of educational programs using conventional techniques difficult. The WCVW recently ran a field trial to deliver required courses directly into the homes of vets located all over Western Canada either by transmitting the courses directly by satellite to those who owned a dish or by satellite to the cable companies which offered them on their networks.

- Carleton University in Ottawa, drawing upon the experience derived from its "wired city" program in the mid-1970s, delivers undergraduate and graduate courses on a local cable television channel.

As in health care, we have become world leaders in tele-education because we have had to. Our expertise results from the dispersal of our population across the top half of the continent. Indeed, we are recognized all over the world for our leadership in this area: both the Commonwealth and La Francophonie have asked Canada to take the lead in developing distance learning centres and television program services for the greater benefit of the members of each of these two great families of nations.

Despite our successes, however, there is evidence of the emergence of certain difficulties:

- questions have been raised whether our current regulatory arrangements can satisfactorily ensure access to the infrastructure which delivers educational programming and courses. For example, there is some evidence that small, non-profit users of satellite services are having difficulty getting access to capacity which meets their needs at prices they can afford; and

- we appear to be falling behind in developing instructional technologies and courseware that reflect Canadian realities and needs. As mentioned in a previous chapter, over 90 percent of educational software currently used in Canada is imported.

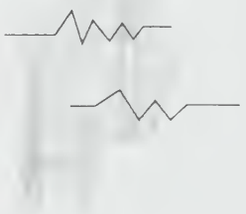
Our continued strengths in tele-education and distance learning will be essential to guarantee the future vitality of our educational infrastructure. Indeed, as many commentators have pointed out, perhaps the most important challenge in managing the transition to the information society will be to ensure that Canada's human resources are of a quality that will enable them to compete effectively in the new economy. In the recent report of the National Technology Policy Roundtable, the Canadian Advanced Technology Association made this point clearly:

"The innovation chain is driven by the creative abilities, knowledge and, eventually, the entrepreneurial skills of a people. Thus, we will only succeed in creating jobs and competitive strength if we are successful in expanding the number of citizens having the skills and aptitudes required for creating an innovative and technologically intensive society."

And in the words of the Information Technology Association of Canada:

"Education and skills training may well determine a firm's — and Canada's — ability to innovate. . . Science and education policies become strategic tools: they should be recognized as trade adjustment policies. . . Post-secondary institutions will be increasingly important in providing continuing education to a work force adapting to change. . . 'Learning how to learn' must become a key component of every post-secondary education program. Universities will experience an increase in the number of part-time students and their culture, organizations, physical plant and faculty strength must change to accept this reality."

The application of information technology to the delivery of education, training, health care and other social services will be one of the central challenges of the information society. Canada must take measures to maintain its leading position in this area, both to benefit its own people and to take advantage of the many commercial and humanitarian opportunities that will arise.



The application of information technology . . . will be one of the central challenges of the information society.

Regional development

Communications . . . technologies are central to the development . . . of Canada's regions . . .

Communications and information technologies are central to the development of each of Canada's regions and to the reduction of regional disparities. Fortunately, Canada's regions all enjoy exceptional telecommunications infrastructures by international standards. Saskatchewan, for example, has been a world leader in the installation of optical fibres. The provincial telephone companies constitute an important asset for ensuring the utilization of information technology for regional development.

Other countries have recognized the potential of communications and information technology to reduce regional disparity. The European Economic Community introduced the $700 million (1987-91) Special Telecommunications Action for Regional Development program (STAR program), which was developed in recognition that the provision of a modern communications infrastructure, while necessary, is insufficient on its own to stimulate regional development. Consequently, measures are planned under STAR to ensure that the development potential of the infrastructure in remote regions is maximized and realized through practical information technology applications reflecting the specific needs of the poorer regions.

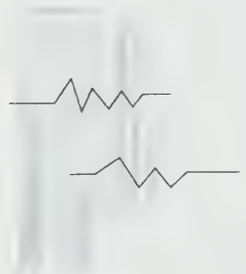
Japan has also introduced a regional development program associated with information technologies, called Teletopia. The Teletopia program is an attempt to integrate the use of advanced information systems and services into regional economies. Scheduled to involve 60 cities by 1990, communications systems that incorporate high-speed transmission, two-way cable and videotex services will be introduced to meet the social and economic needs of each particular community. The program is intended to promote the use of advanced information technologies by the general public and present new opportunities for economic growth and diversification in Japan's poorer regions.

If properly deployed and used, communications and information technology can assist in the development of Canada's regions. However, this can only occur if Canadians in all parts of the country have access to advanced telecommunications facilities and services. This in turn requires the federal and provincial governments to harmonize two fundamental policy objectives.

If properly deployed and used, communications and information technology can assist in the development of Canada's regions.

On the one hand, as we noted earlier, many provinces have pursued regulatory regimes that are more restrictive than those in federal territories. This has tended to limit the range of equipment and services available in the western and eastern provinces in comparison with those offered in Ontario, Quebec and British Columbia. Increasingly, information-intensive firms will be reluctant to locate in regions that do not offer a competitive range of communications services, while the information-based firms that are already there will operate at a competitive disadvantage. For these reasons, the federal government believes that the achievement of equitable regional development opportunities requires agreement with the provinces on a national telecommunications policy that features common standards and rules across the country.

On the other hand, policies to provide compatible telecommunications regulations must be complemented by policies which ensure that advanced communications facilities continue to develop in all parts of the country at more or less comparable rates. The construction of new communications systems, such as the fibre optic-based integrated services digital networks discussed in the previous chapter, will entail massive capital expenditures over the next two or three decades. Provinces which own or regulate their own telephone companies are naturally concerned that standardized interconnection rules be introduced in a way that does not undermine the economic health of these companies. Were this to happen, they would be unable to make the necessary investments in new facilities, and regional disparities inevitably would be exacerbated.



. . . ensure that advanced networks are available to business and residential users in all regions of Canada.

As we move into this new communications era, it will be essential for the federal government and the provinces to work together to ensure that advanced networks continue to be available to business and residential users in all regions of Canada.

Developing the telecommunications infrastructure is one challenge: using it effectively is another. This means applying information technology to enhance the industries that are already strong and to build on the existing labour force and structural strengths in each region to attract new ones.

Unfortunately, there is some evidence that we are already falling behind in some respects. For example, our ports infrastructure, the lifeblood of the shipping industry in the Maritimes, is not keeping pace with developments in the countries with which we compete. Along the eastern seaboard of the United States, the ports of New York, Boston and Miami are installing electronic data interchange systems to automate their paper flows. It is estimated that these systems will cut associated costs by 50 percent. Certainly it will make their ports more competitive than ours.

. . . take advantage of information technology to establish new businesses in all regions of the country.

As well as applying technology to improve the competitiveness of established industries, we must also strive to create opportunities in the regions for new information-based activities. Because these activities largely depend on good communication and good information — not on raw materials, energy, proximity to markets and the other factors that have traditionally shaped regional economic development in Canada — they can, in principle, be located anywhere. There is encouraging evidence that Canadian entrepreneurs are already beginning to take advantage of information technology to establish new businesses in all regions of the country. For example:

- Teli-Graphics of North Wiltshire, Prince Edward Island uses a Telidon system to provide information to tourists on hotels, restaurants, entertainment, historical sites, shopping and weather.

- Nordco, of St. John's Newfoundland uses satellites and remote sensors to provide a variety of services to the resource industries, such as iceberg information to off-shore drilling rigs, statistics on forests and forest fire warnings to the wood products industry, and information on fish stocks to fishermen.

- Quinte Computer Services of Belleville, Ontario provides custom-tailored software to small businesses both locally and abroad. Using satellite links, the company serves customers in Scotland, France, Germany and Japan.

- Knudsen Engineering of Perth, Ontario designs and manufactures advanced electronic products, focussing in particular on airborne remote sensing systems and underwater acoustics. Its products are used by some of the world's leading oil exploration firms, principally in the Arctic.

- Rescom Ventures of Manitoba has developed personal computer software for stock and commodity brokers, including a "talking ticker tape" which gives voice synthesized quotations and can be accessed over the phone.

These examples illustrate the opportunities available to all Canadians in the information age. To realize this promise, we must ensure that the application of advanced communications and information technology becomes a core element of our regional development strategies.

6
RESEARCH

Daniel Bell, one of the most far-sighted observers of the information society, pointed out 15 years ago the central role that knowledge plays in the new economy. He wrote:

"In the coming century, the emergence of a new social framework based on telecommunications may be decisive for the way in which economic and social exchanges are conducted, the way knowledge is created and retrieved, and the character of the occupations and work in which men engage. This revolution in the organization and processing of information and knowledge, in which the computer plays a central role, has as its context the development of what I have called the post-industrial society. . . The axial principle of the post-industrial society, however, is the centrality of theoretical knowledge and its new role, when codified, as the director of social change."

In the past, innovation was based largely on experience; today, it is based on research. Every aspect of the information society, from the new messages, to the new networks, to applications of technology in everyday life, is based on the generation of knowledge through research.

The communications research challenge

In the past, innovation was based largely on experience; today, it is based on research.

Although Canada's overall R&D effort is generally acknowledged to be weak, the information technology sector appears to be an exception.

- Canada's computer and telecommunications industries spent about $1 billion on R&D in 1986 and accounted for about 30 percent of total industrial R&D expenditures. Bell Canada Enterprises (BCE), Canada's largest R&D spender, spent some $623 million on R&D that year — 22 percent of all R&D expenditure by Canada's private sector.

- A number of Canadian universities are major communications and information technology R&D performers. The University of Waterloo, for example, is recognized worldwide for its achievements in computer software engineering and networking.

- Communications Canada runs Canada's largest program devoted to medium and longer-term applied research in communications and information technology. Although the department's laboratories exist principally to serve federal government needs, they have had a strong involvement with industry over the years and have been instrumental in supporting the growth of a number of leading communications firms.

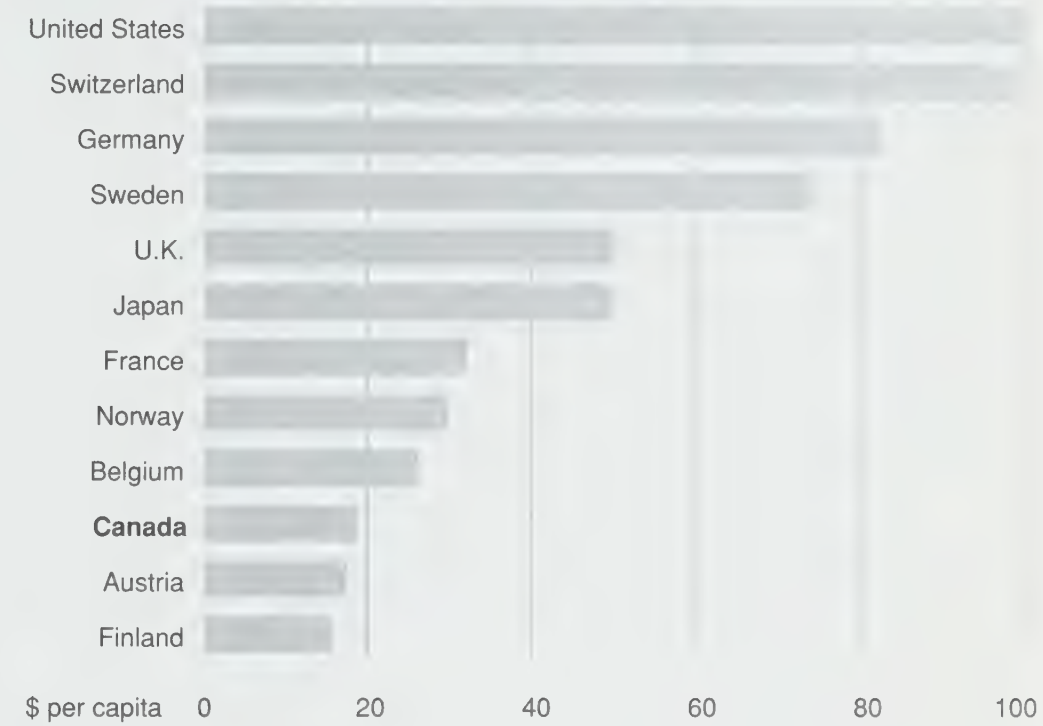
CHART 16
MAJOR CANADIAN COMMUNICATIONS AND COMPUTER R&D SPENDERS

	1986	
	$ million	
Bell Canada Enterprises	623.0	
IBM Canada	89.0	(1985)
Mitel	51.8	(1985)
Communications Canada Research Program	**44.0**	
B.C. Telephone	27.5	
Control Data Canada	25.0	
Gandalf Technologies	13.1	
Spar Aerospace	12.0	
ITT Canada	8.4	
Cognos	6.8	
Comterm	5.2	

Source: *Financial Post*, October 25, 1986 and Communications Canada ADMTT Management and Plans Branch

In spite of the relative health of communications and information technology R&D in Canada, we fare poorly when compared to other industrial nations. A 1984 OECD report ranked Canada tenth in terms of per capita expenditures for research and development in information technology related areas, behind all of our major trading partners. According to this report, we spent $18 per capita on R&D in information technology, compared, for example, to $100 in the United States and $50 in Japan.

CHART 17
INFORMATION TECHNOLOGY RELATED R&D EXPENDITURE



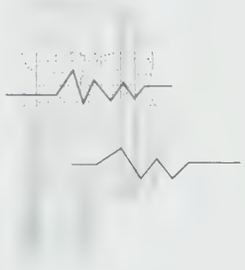
Source: OECD 1984 (1979 data)

The gap between Canada and the other OECD countries has probably widened . . .

The gap between Canada and the other OECD countries has probably widened in the years since that report was written. In recognition of the strategic importance of information technology products, services, networks and applications to future development and growth, most OECD countries have, over the past decade, invested public resources in programs designed to increase the amount of information technology research done by their domestic industries and to improve the transfer of technology from university and government laboratories to the private sector, where it can be exploited commercially.

Information technology R&D was given impetus at the beginning of the present decade by a series of R&D initiatives that followed the launch in 1982 by Japan of the "fifth generation computer research program." The objectives of this program, worth $1 billion over 10 years, are to:

- apply advanced information technology to those areas of society where increases in efficiency and productivity could be most beneficial;
- use the technology for knowledge processing rather than for data processing and computation;
- improve the ease with which the technology can be used; and
- make the technology more widely and cheaply available.



Canada's national R&D effort in information technology clearly lags behind that of other nations.

In Europe, there are a number of national programs including the "Filière Electronique" in France, the Information and Communication Technology Promotion Program in the Federal Republic of Germany, and "SPIN" in the Netherlands. In the United Kingdom, the "Alvey" program is a five-year, $700 million program aimed at encouraging the development of pre-competitive research consortia involving industry and university partners.

In Europe, these national programs have been augmented by several multilateral programs:

- ESPRIT (European Strategic Program for Research and Development in Information Technology) has been established by the European Economic Community (EEC) as a key element in its industrial strategy. ESPRIT is a 10-year multi-phased program designed to encourage firms in member countries to co-operate in developing advanced information technology. The budget for the first five years was established at $1.5 billion.
- Another major EEC initiative, budgeted at $2.1 billion over its first five years, is RACE (Research and Development in Advanced Communications Technologies in Europe). RACE is focussed on R&D for the creation of a Europe-wide integrated services digital network (ISDN).

Although it has no formal national program comparable to Japan's fifth generation computer research program or to the United Kingdom's Alvey program, the United States is injecting billions of dollars into information technology R&D through defence spending, notably through the Strategic Defense Initiative and the 10-year, $600 million Strategic Computing Project launched by the Defense Advanced Research Projects Agency. Public expenditures aside, the huge U.S. multinationals, IBM and AT&T, have annual R&D budgets that are equivalent to state-sponsored programs in most other countries.

Canada's national R&D effort in information technology clearly lags behind that of other nations. It is evident that apart from the handful of major companies identified in Chart 16, the vast majority of firms are too small to mount sustained R&D efforts on their own. Furthermore, the overwhelming presence of Bell Canada Enterprises means that Canada's information technology R&D efforts are concentrated on the needs of the telephone industry. As a result, Canada's R&D effort in other areas of information technology has been significantly below that of our major trading partners.

In March 1987, the federal government announced a national science and technology policy entitled InnovAction. It stressed the need to improve the productivity and competitiveness of the Canadian economy by assisting industry in identifying and securing economically exploitable niches in strategic technology areas and improving the transfer and commercial application of new technologies through greater government-industry-university co-operation. The principles underlying this policy have been supported by all the provinces.

. . . the vast majority of firms are too small to mount sustained R&D efforts on their own.

The main challenge that Canada faces in implementing InnovAction in the field of communications and information technology is two-fold:

- We must find ways of establishing better links between the research activities of universities, government laboratories and industry — particularly those small and medium-sized firms that are the source of much product and service innovation but which are too small to mount significant R&D programs on their own.

- We must also find ways to encourage a more rapid application of communications and information technology, particularly in those sectors of the economy where the competitiveness of established industries is threatened, but also to create new business opportunities in all regions of the country, principally in the information-based service industries which will be the source of much of our future economic growth.

It should be emphasized that our success in responding to these challenges will be determined by a number of factors. The tax regime, for example, exerts a massive influence on the nature and level of R&D investments as well as on the rate at which industry applies technology.

It should be emphasized that our success in responding to these challenges will be determined by a number of factors.

The structure of the Canadian economy (which has historically been dominated by a non research-intensive primary sector), and our patterns of industrial ownership, also significantly influence Canada's overall R&D performance. Branch plants invest less than indigenously-owned industries in R&D in all sectors of the economy. With a couple of notable exceptions, this is also true of the information technology sector.

Beyond this, the nature of Canada's culture and the extent to which it is science-oriented affect not only individual career choices but our overall performance as measured against other nations.

In shaping a policy response to the InnovAction challenge, it is clear that all these factors must be taken into consideration. It is equally clear that government-sponsored research must have a role to play in improving the quality and effectiveness of Canada's communications and information technology research infrastructure. As the Canadian Advanced Technology Association noted in its September 1986 report of the National Technology Policy Roundtable,

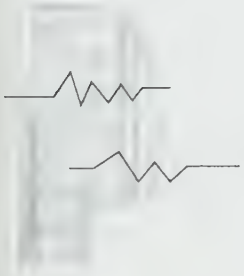
"governments in Canada must accept responsibility for ensuring that Canadian universities and/or government labs maintain a strong and healthy base of fundamental research and research training in Canada. Canadian industry is not structured to perform this role."

In addition, CATA took the view that "industry-led, sectoral initiatives in pre-competitive R&D should be encouraged with universities and government providing support."

It has often been noted that on Canada's national research balance sheet, the federal government carries out proportionately more R&D than is the case with other countries while the private sector does proportionately less. As Chart 16 makes clear, this is not so in communications and information technology.

At $44 million, Communications Canada's research program represents only about 5 percent of the total Canadian effort. It is, however, the largest body of research in the country devoted to medium to longer-term applied research. Unlike the R&D programs of Bell and the other large companies, which tend to focus on their own short-term needs, Communications Canada's research program provides a base of longer-term work in a number of important segments of the communications and information technology R&D spectrum.

Since the end of the Telidon program in 1985, Communications Canada's research activities have been oriented primarily toward the needs of clients in the Department and other federal government departments. The major part of the resources of the Communications Research Centre located at Shirleys Bay, just outside Ottawa, are devoted to supporting the department's missions to regulate the radio frequency spectrum, to develop broadcasting and telecommunications policy and to support the development of international standards. In addition, a substantial amount of work is done on radar and military communications for the Department of National Defence.



. . . Communications Canada's research program provides a base of longer-term work . . .

As Canada's principal public sector supporter of communications and information technology research, the main question Communications Canada faces, in light of InnovAction, is whether this inward-looking posture continues to be appropriate. The priority which the federal and provincial governments have given to regional development, industrial competitiveness and technology diffusion suggests otherwise. In light of this imperative, two new research challenges clearly face Communications Canada in the years ahead:

- It must find ways of strengthening its links to the communications and information technology industry — in particular, to small and medium-sized firms whose R&D needs are not served by Bell and the other major telephone companies — in order to ensure that these firms benefit as much as possible from public investments in R&D;

- It must also strengthen its links with industrial and institutional users of communications and information technology in order to contribute to a more rapid application and diffusion of these technologies throughout our society.

Over the last few months, Communications Canada has taken several steps in response to these challenges.

Increased client responsiveness

As a first step in making Communications Canada's research program more responsive to the priorities of the communications industry and other members of the communications research community, the department 's laboratories have been reorganized into four core technology areas to serve the needs of key client groups better. These are:

- communications technologies and systems;
- communications devices and components;
- video and broadcasting technologies; and
- office automation technologies.

Advisory committees made up of representatives from industry, universities and provincial laboratories will be established for each of the new groupings. The committees will review work plans and recommend priorities.

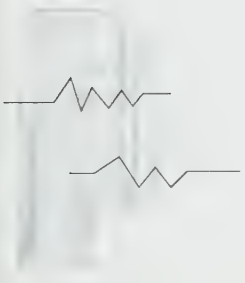
A second step toward greater client responsiveness will be the development of research partnerships which make the department's research resources more accessible to laboratories in all regions of Canada. This is particularly important because all provinces recognize the need for access to research as a means of promoting economic and social development across the country. Partnership agreements, therefore, are being sought with other laboratories to share knowledge and results.

Partnership agreements, therefore, are being sought with other laboratories to share knowledge and results.

These new directions will be reinforced by an increased emphasis on contracting out and personnel exchanges with industry. The Department is also actively exploring the possibility of privatizing certain R&D functions as they mature.

Taken together, these measures will increase considerably the responsiveness of Communications Canada's research program to its counterparts in the provinces and to its potential partners in the private sector. However, they are not on their own sufficient to ensure that the Department contributes to a more rapid application of information technology throughout the Canadian economy and society.

Promoting the application of technology



. . . this challenge involves combining . . . technology development with expertise in . . . applications areas.

As noted in the previous chapter, the major challenge for the foreseeable future will be to ensure that Canadians can use and apply information technologies effectively to meet economic and social needs.

Responding to this challenge involves combining skills related to technology development with expertise in particular applications areas. The Department has already established one research centre with such a mission — the Canadian Workplace Automation Research Centre (CWARC). By drawing on the strengths of Communications Canada's labs in communications technologies and combining them with a knowledge of the practical problems in real workplaces, it can come up with specific solutions to meet concrete needs.

CWARC is structured in a way that is unusual for government laboratories. Its program is guided by a private sector advisory board made up of experts from industry and the university community. Approximately half of its staff come from the private sector and will ultimately return there — a key element in the technology diffusion process. Upwards of one quarter of CWARC's budget comes from the private sector; it is anticipated this figure will eventually rise to well over 50 percent. Since the facility is located in Montreal, it contributes to the growth of information technology-based firms in the area.

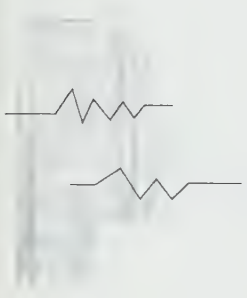
The question arises whether CWARC should be used as a model for promoting the application of communications technology in other areas and for examining a number of related questions. Given the generally slow speed of technology diffusion in Canada, could such centres be used as forcing houses for change? If appropriately located, could these centres help to reduce regional economic disparities? More specifically, since traditional resource industries and the social services appear to be the slowest to take up the technology, should we target these as areas for particular attention by creating application centres in such areas as mining, fishing, health care and learning?

Future questions

Beyond issues of direct concern to Communications Canada, it is clear that success in dealing with many of the complex questions discussed in previous chapters — whether they concern the new information industries, emerging telecommunications networks or technology applications — will require a stronger national effort in communications and information technology R&D. Three issues stand out:

1 There is an urgent requirement to assess the R&D needs of the Canadian software industry. Software is at the heart of progress in all areas of communications and information technology. Our industry faces major challenges in developing the artificial intelligence and software engineering techniques that will be required to take advantage of new computer architectures. Canada currently lacks a coherent publicly-supported R&D program in these important fields, and it is by no means obvious that private efforts alone will be sufficient to maintain the position of Canada's software industry as we move toward fifth generation applications.

2 Measures designed to achieve a more effective use of existing resources are not, in themselves, sufficient to maintain Canada's position as a world leader in communications and information technology R&D. New resources must be devoted to this area in order to obtain higher levels of private sector participation. However, in line with the principles of InnovAction, additional public investments should not be used to build new government laboratories or to conduct in-house government R&D. Instead, they should be spent in conjunction with industry and the university community to extend the kind of partnership arrangements described above.



If we do not, we will almost certainly fall further behind our major trading partners.

3 We must make major efforts to encourage the application of communications and information technology throughout our economy and society. The competitiveness of our industries and the quality of our social services will increasingly depend on our ability to use technology effectively. If we systematically begin to establish applications centres of the kind described above, we will be in a better position to assess whether there are requirements for a larger-scale national effort in this direction.

There are many difficult questions surrounding the role of government research in any field. This is particularly the case in communications and information technology, where there is a good deal of private sector strength. Whether the general approach proposed in this chapter is the right one remains to be seen. What is absolutely clear is that we must begin the process of forging a national consensus on how to strengthen our efforts in this critical area. If we do not, we will almost certainly fall further behind our major trading partners.

7
CONCLUSIONS

Canada, like every other industrialized nation, is going through a major shift in the structure of its economy and its culture. This shift involves the movement toward a more information-based society, driven and enabled by the emergence of an integrated information technology that has resulted from the merger of computing and communications. This new information technology is a "transformative" technology that will radically change the way we work and live.

Already the signs of change are appearing. The emergence of paperless offices, the use of "courseware" in schools and training centres, the monitoring of patients at great distances from hospitals, the automation of the world's banking and financial systems, the automation of trade practices, the introduction of robots in factories, the delivery of education to the third world by satellite, the availability of a hundred or more television signals to anyone in North America with a receiving dish, machine access to the store of all scientific knowledge. All of these developments are already with us, but the OECD estimates that these constitute only 10 to 15 percent of the changes that we will see by the year 2000.

This new information technology is a 'transformative' technology that will radically change the way we work and live.

Canada has great strengths in certain aspects of the new information technology. It is now — and has been for nearly a century — a world leader in communications. Its broadcasting, cable and telecommunications networks are second to none. We are world leaders in digital switching and radio technologies. Our communications engineering and systems consulting firms are among the most competitive.

Canada became strong in these areas because we had to. Being next door to one of the most dynamic countries in the world, we had to struggle to ensure our integrity. Strong communications links tying various regions together were a central aspect of this effort.

But so too was the requirement to ensure that the content which flowed through these links reflected Canadian realities. We have had to struggle throughout our history to ensure that a meaningful Canadian voice can be heard in our own country. The great efforts associated with the building of the national broadcasting system and a vigorous publishing industry have been equally central to our national project.

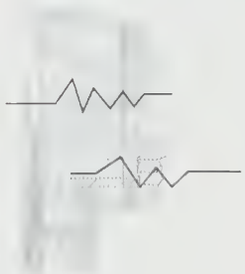
As we enter the information age, these two great challenges of ensuring the vitality of both the media and the messages remain. They are now more pressing, however, since information is no longer crucial just to our cultural life, but is an increasingly important component of economic activity. Where the old information products of newspapers and books were important to our identity, the new information products of software and databases are critical to our future prosperity.

Unfortunately, when we consider the state of our industries in these areas, there are clear indications of danger ahead.

- Our database industry is underdeveloped. If we are not careful, we may see this industry dominated by foreign firms in the years to come. Not only would this reduce an area of potential economic growth, it is also likely to limit its capacity to contribute to our cultural life.

- The software industry, while enjoying some pockets of strength, is concentrated in the lowest growth areas. In the newer areas of packaged software, our market is dominated by foreign suppliers. The few firms we have are badly underfinanced and are experiencing difficulties in distributing their products. But not only do they lack the financial base for success, unlike other countries they do not have access to a pool of research.

Unless these problems are corrected, we will find ourselves dangerously weak in these key areas. This would damage us both culturally and economically.



. . . these two great challenges of ensuring the vitality of both the media and the messages remain.

As far as the networks — the electronic highways of the information age — are concerned, we are very strong technically and financially.

As far as the networks — the electronic highways of the information age — are concerned, we are very strong technically and financially. Our current problems are not industrial, but jurisdictional and regulatory. The central issue is that jurisdiction has been split between the provinces and the central government and that policies were developed in isolation without sufficient consultation, with the result that we have not one but a multitude of telecommunications markets operating under different rules and policies. This has inhibited the national development of new services which are essential to industrial competitiveness and which are beginning to become available in other countries.

It is apparent that we must have a national telecommunications policy. The Government has already announced a first step in this direction by adopting a policy framework for the future evolution of the system. The next step is to settle on a new set of jurisdictional arrangements with the provinces to ensure that both levels of government can co-ordinate their activities effectively.

Over the longer term, the federal and provincial governments will have to co-operate to foster the development of the powerful new networks that are the future of telecommunications — particularly fibre optic-based integrated services digital networks — and to ensure that they are available to business and residential subscribers in all regions. These networks and the expanded range of voice, data and video services they will carry will lead Canada into the information age of the twenty-first century.

With these arrangements in place, Canadians will be better positioned to address one of our greatest national problems — the relatively slow rate at which we are applying communications and information technology to help meet the challenges of economic and social development. The Americans, the Japanese and the West Europeans are all beginning to outpace us in the deployment of these technologies. We must do better if we hope to keep up.

The application and use of communications and information technology must become a national priority. We must ensure that our concerns cover a broad range of potential applications — in the services sector of the economy, in manufacturing, in traditional resource-based industries and in the delivery of government and social services, particularly in the health and education sectors.

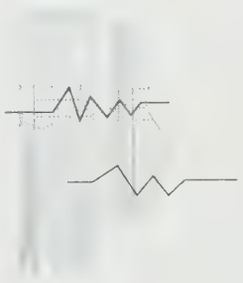
The use of information technology for regional development must become a national priority. It is here that the 'distance-insensitive' character of the technology offers the greatest potential for revitalizing traditional industries and creating new opportunities. But it is also here that the challenges are greatest, since it is the disadvantaged regions that are taking up the technology most slowly.

The use of information technology for regional development must become a national priority.

All of these technologies, their associated industries and their applications are research-intensive. Here, too, we are in danger of falling behind. Our per capita spending on information technology R&D is approximately one fifth of that of the United States and, according to a 1984 report, ranks us tenth in the OECD. We must do better. We must expand our national effort in communications and information technology R&D effort and focus it on the applications of the technology.

The purpose of this paper is to provide points for public discussion. It does not offer definitive solutions, nor does it cover all of the issues. It is written as a contribution to the overall debate from the particular point of view of Communications Canada. As such, it focusses on our preoccupations with messages and media, but in so doing, it touches on many other topics that are central to the new information age and that are of concern to the provinces and other federal government departments.

Even so, much more could have been discussed. As both the Information Technology Association of Canada and the Canadian Advanced Technology Association have pointed out, the quality of our educational system, the tax treatment of R&D, the availability of labour adjustment programs and the effectiveness of our managerial classes are all essential components of a comprehensive response to the challenge of the "Information Age."



This paper represents the start of what we hope will become a major national discussion. It is both a call to action in certain areas of weakness and an affirmation of our great strengths in others. It attempts to take stock of where we are now, so that we can move forward more effectively into the future.

This paper represents the start of what we hope will become a major national discussion.